Prepared for

The Boeing Company
7500 East Marginal Way South
Seattle, Washington

FINAL REMOVAL ACTION WORK PLAN: LONG-TERM STORMWATER TREATMENT

NORTH BOEING FIELD

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1 INTRODUCTION

The Boeing Company (Boeing) has conducted operations at North Boeing Field (NBF) since the 1940s. NBF is located at 7500 East Marginal Way South in Seattle, Washington, and is used for research, flight testing, aircraft finishing, and delivery facilities. Stormwater from NBF is collected and conveyed by storm drains to Slip 4 of the Lower Duwamish Waterway (LDW), which was placed on the National Priorities List (NPL) for polychlorinated biphenyls (PCBs) in 2001 pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or Superfund, with oversight by the United States Environmental Protection Agency (EPA). In 2003 the sediments and portions of the banks of Slip 4 were identified as an Early Action Area. In 2007 the Washington State Department of Ecology (Ecology), the lead for source control at the LDW Superfund Site, identified NBF as a significant continuing source of PCBs to the LDW.

EPA and Ecology have been working with Boeing, the City of Seattle, and King County, to eliminate sources of PCBs in stormwater discharges to Slip 4. On September 29, 2010 Boeing entered into an Administrative Settlement Agreement and Order on Consent for Removal Action (ASAOC) with the EPA. The ASAOC requires that Boeing address the discharge of PCBs to Slip 4 Early Action Area through short-term and long-term stormwater treatment (STST and LTST, respectively) removal actions. The STST system is currently installed and operational. The LTST must be installed and operating by September 31, 2011. In addition, source removal actions (i.e., joint caulking removal/replacement and other source control removals) are continuing.

As defined in the ASAOC, “stormwater” shall mean all liquids, including any particles dissolved therein, in the form of base flow, storm water runoff, snow melt runoff, and surface runoff and drainage, as well as all solids which enter the storm drainage system. “System” shall mean the combination of all man-holes, catch basins, pipes, and other drainage devices and conveyances designed, constructed and utilized for the purpose of carrying stormwater from NBF to Slip 4 of the LDW, and the drainage basin associated with these devices and conveyances.

1.1 <u>Site Location</u>

NBF occupies approximately 132 acres and is located approximately 4 miles south of downtown Seattle (Figures 1 and 2). NBF is adjacent to the Georgetown Steam Plant

(GTSP) to the north and the King County International Airport (KCIA) to the east. Slip 4 Early Action Area of the LDW is located across Marginal Way, approximately 150 feet southwest of the NBF site boundary. Surrounding land uses are predominantly industrial with some residential to the northwest along Ellis Avenue South.

For the purpose of this work plan, runoff from the GTSP and the KCIA is considered "off-site" runoff (Figure 3). Runoff from NBF includes that from the Building 3-380 area, four major storm drain laterals (North, South-Central, North-Central, and South laterals), and the parking lot area (Figures 4 and 5). The major storm drain laterals are directed to the King County Lift Station (Figure 6), which directs flows to the 60-inch KCIA Storm Drain #3/PS44 (SD#3/PS44) Emergency Overflow (EOF) outfall at the Slip 4 Early Action Area. The Lift Station also prevents tidal backwash from entering the storm drain system. Several NBF parking lots (approximately 6 acres) drain to SD#3/PS44 downstream of the Lift Station. The attached storm drain structures map (Figure 4) also indicates the preferred location for constructing the LTST system regardless of lateral(s) treated, or approximately 900 feet north of the lift station, within the North lateral drainage area.

1.2 Scope of Work

In compliance with the ASAOC requirements, Boeing has tasked Geosyntec Consultants (Geosyntec) with preparing a Removal Action Work Plan for Long-Term Stormwater Treatment (Work Plan). The scope of this Work Plan, as set in the ASAOC is to:

- Outline the implementation of the removal action, including how the construction activities are to be implemented by Boeing and coordinated with EPA;
- Describe, and provide a schedule for, the actions, including all bidding processes for necessary personnel and equipment; and
- Identify LTST solutions that could be constructed onsite by and for Boeing.

1.3 Terms of Reference

The work described in this report was conducted by Geosyntec Consultants for The Boeing Company (Boeing) North Boeing Field (NBF) (7500 East Marginal Way South, Seattle, Washington) for the USEPA. The primary authors of this work plan were Megan Patterson, P.E. and Paul Hobson under the direction of Eric Strecker, P.E., and

Brandon Steets, P.E.. This report was peer reviewed by David Parkinson, Ph.D., R.G., in accordance with Geosyntec's quality assurance protocols.

2 PROJECT GOALS

Boeing is committed to minimizing the potential of post-remediation recontamination of the Slip 4 Early Action Area. As feasible, the LTST system (i.e., a natural/passive or active stormwater treatment system) and source controls will be designed to meet the Interim Goals for PCBs. The plan's effectiveness will be assessed through long-term monitoring at the compliance point. The current Interim Goals for PCBs in water and solids and recommended compliance point are discussed below.

2.1 PCBs in Water and Solids Interim Goals

The goal of the LTST removal action is to treat stormwater runoff to remove polychlorinated biphenyls (PCBs), the chemical of concern driving the need for time critical removal action, prior to discharge from the NBF via the KCIA Storm Drain #3/PS44 Emergency Overflow (EOF) to Slip 4 (SAIC, 2010a and USEPA, 2010a). As feasible, the LTST system and source controls will be designed to meet the long-term Interim Goals outlined in the ASAOC SOW for PCBs in solids and water at the point of compliance (Table 1).

Table 1:Long-Term Interim Goals for PCBs in Water and Solids Discharged to Slip 4

Matrix	Description	Reference	Value
Water	Aquatic Life – Fresh/Chronic current Interim Goal	USEPA, 2010a	0.014 μg/L
	Aquatic Life - Marine/Chronic Interim Goal; pending results of Salinity Study	USEPA, 2010a	0.030 μg/L
Solids	Total dry weight current Interim Goal	USEPA, 2010a	0.1 ppm (mg/kg)
	AKART Analysis derived goal	USEPA, 2010a	TBD
	Sediment Quality Standard adjusted for site specific TOC (recommended by Landau as an alternative to the 0.1 ppm Interim Goal)	Landau Associates, 2010e	0.42 ppm

The Lower Duwamish Waterway is a tidally-influenced water body with highly variable salinity depending on location, tidal conditions, flows, and storm water influences. Applicable water quality criteria (marine or freshwater) for Slip 4 are dependent upon the salinity levels within the slip. As specified in the ASAOC SOW, the freshwater chronic aquatic life Interim Goal for PCBs in water discharged to Slip 4 is 0.014 micrograms per liter (μg/L) total PCBs. The marine chronic aquatic life standard is 0.030 μg/L total PCBs. In the absence of site-specific salinity data, the more stringent freshwater quality criteria apply. A slip salinity study is currently being planned and is scheduled to begin within the next several months to determine the applicable goal.

The ASAOC Interim Goal for PCBs in storm drain solids discharged to Slip 4 is 0.1 parts per million (ppm) dry weight total PCBs. Based on correspondence from SAIC to EPA dated January 29, 2010, Appendix C of the ASAOC states that "the current derivation of the Slip 4 sedimentation model predicts that a maximum bulk storm drain solids concentration of 0.1 ppm PCBs will not recontaminate Slip 4 sediments above 0.13 ppm PCBs…". The 0.13 ppm is based on the Washington State Department of Ecology (Ecology) Sediment Quality Standard (SQS) of 12 ppm organic carbon (Washington Administrative Code [WAC] 173-204-320), translated to a dry weight of sediment using an assumed percent Total Organic Carbon (TOC) content for the sediments. The current Interim Goal has no lower loading rate limitation (i.e., a PCB mass load-based threshold, below which the solids Interim Goal would not be used for compliance assessment purposes), which would also be important in assessing the potential for sediment recontamination (i.e., it is PCB mass loading to the Slip that ultimately dictates Slip sediment recontamination, combined with other factors like solids particle size distribution and PCB fractionation by particle size). This Interim Goal may change pending the outcome of the all known, available and reasonable methods of prevention, control and treatment (AKART) analysis, at which point a long-term Interim Goal that meets AKART will be selected by EPA. Boeing has also proposed using a remediation level of 0.42 parts per million (ppm) dry weight total PCBs which is based on the 12 ppm organic carbon SQS screening level normalized by a site-specific TOC of 3.5 percent (Landau, 2010c). Until the AKART analysis has been approved by EPA or additional monitoring data is provided to justify using the proposed remediation level, the Interim Goal of 0.1 ppm shall be considered in the design of the LTST facility.

2.2 Point of Compliance

The lift station is identified by EPA as the point of compliance since storm drain discharges here represents 92% of the NBF on-site drainage area. The remaining 8% of the area is known to have relatively lower PCB solids concentrations (Landau, 2010b). The lift station is also the furthest downstream location in the storm drain system that is not impacted by tidal flushing and PCB-containing sediments from Slip 4. Downstream of the lift station, such as CB433 or at the outfall, water and solids samples would not be representative of pure NBF storm drain discharges (although the lift station also does currently include upgradient offsite contributions).

3 TREATMENT DESIGN CRITERIA

EPA has identified Interim Goals for PCBs in both water and solids discharged to Slip 4. These performance standards will be used in combination with flow, water quality, and solids monitoring data to identify the drainage area(s) recommended for treatment. It is assumed in this work plan that all or a portion of off-site runoff (i.e., areas entirely upstream of the NBF site [Figure 5]) will be re-routed around the NBF[1]. As such, current plans are for the LTST system and source controls to address on-site storm drain flows and sources only. While the Active Treatment System (ATS) and source controls described in the STST Work Plan (Landau, 2010b) are intended to bring NBF stormwater discharges toward compliance with the STST water and solids performance standards in the short-term (i.e., through start-up of the LTST system), the LTST system and additional source controls are intended to bring NBF storm drain discharges toward compliance with the LTST water and solids performance standards in the long-term (i.e., through cleanup of the NBF site, to the point where Slip 4 recontamination potential is minimal). Several key factors are expected to impact the ultimate location and design of the LTST system, including: the effectiveness of ongoing and planned source controls, the re-routing plan for off-site storm drain flows (e.g., whether some or all upstream laterals will be re-routed), the STST performance monitoring results (particularly PCB water and solids concentrations measured at the lift station), revised drainage area boundaries (currently being reviewed by Landau), continued storm drain flow rate monitoring data for the north lateral and lift station (to inform treatment system sizing), and other ongoing monitoring data collection efforts. The following sections discuss information considered as part of the LTST system design effort.

[1] For the purposes of this early planning effort, we assume that all upgradient off-site laterals will be re-routed around the NBF and lift station. If only a subset of laterals are ultimately re-routed, the prioritization will be based on PCB water and solids concentrations measured nearest the locations where the laterals cross the NBF site boundary such that the Interim Goals can be met at the lift station (i.e., the lateral(s) with the highest contributing PCB water and solids concentrations would be routed around the NBF and lift station first; at this time the North lateral has been identified as the highest contributor of off-site PCB loads and will be prioritized for rerouting over the other off-site laterals). The objective would be to reroute only as much offsite flow as is necessary to achieve compliance with the Interim Goals at the lift station. Any North lateral re-routing efforts will be scheduled to be completed prior to the LTST system startup. Re-routing of laterals other than the North line, if that is determined to be necessary, may require additional time to implement.

3.1 Drainage Area Boundaries

The drainage areas to the NBF laterals were obtained from Landau and are represented in Figure 5. Boeing, SAIC, and Landau are currently working to refine the delineations of the drainage areas to the NBF laterals to more accurately represent the NBF runoff. It is anticipated that this effort will be completed in January of 2011. For the purposes of this Work Plan, the areas presented in the Landau STST system Work Plan are used to calculate the runoff volumes and PCB loads for an initial assessment of where the LTST system should be sited, until the refined areas are available. For future LTST submittals, revised drainage area boundaries may be used.

3.2 Summary of Relevant Water and Suspended Solids Data

Storm drain sampling at NBF has been conducted to characterize the quality of site runoff and to evaluate the effectiveness of implemented source control actions. Both stormflow (wet weather) and base flow (dry weather) samples have been collected and analyzed for PCBs and TSS, among other parameters. Both whole water and suspended solids (specifically filtered and sediment trap samples) have been collected. Continuous flow measurements have also been recorded at LS431 and MH108 since September of 2009. Available data that are relevant to the design of the LTST system are summarized in Table 2 below. These data were used to calculate lateral-specific loads in Section 3.3.

Table 2. Summary of Relevant Water and Suspended Solids (Filtered and Sediment Trap) Sampling Events, 2005-2010

Type	Analytical Group	Monitoring Location	Lateral	Number of Samples	Date Range	Weather	Source[d]
Flowrate	Hydrologic	LS431	Lift Station	Continuous[a]	9/2009 - 7/2010	Wet and Dry	A
		MH108	North	Continuous[a]	9/2009 - 7/2010[b]	Wet and Dry	A
Filtered Solids	Grain Size	CB165	North	1	4/2010 - 6/2010	Wet	B
		CB173	North	1	4/2010 - 6/2010	Wet	B
				1	4/2010 - 6/2010	Dry	B
		CB423	Bldg 3-380	1	4/2010 - 6/2010	Wet	B
		LS431	Lift Station	8	10/2009 - 6/2010	Wet	B
				2	3/2010 - 6/2010	Dry	B
		MH108	North	8	10/2009 - 6/2010	Wet	B
				2	3/2010 - 6/2010	Dry	B
		MH133	North	4	4/2010 - 6/2010	Wet	B

Type	Analytical Group	Monitoring Location	Lateral	Number of Samples	Date Range	Weather	Source[d]
		MH152	North	2	4/2010 - 6/2010	Wet	B
		MH178	North	3	4/2010 - 6/2010	Wet	B
		MH434	Parking Lot	2	4/2010 - 6/2010	Wet	B
	PCBs	CB165	North	3	4/2010 - 6/2010	Wet	B
		CB173	North	3	4/2010 - 6/2010	Wet	B
		CB423	North	3	4/2010 - 6/2010	Wet	B
		LS431	Lift Station	11	10/2009 - 6/2010	Wet	B
				2	3/2010 - 6/2010	Dry	B
		MH108	North	10	10/2009 - 6/2010	Wet	B
				2	3/2010 - 6/2010	Dry	B
		MH133	North	2	4/2010 - 6/2010	Wet	B
		MH138	North	2	4/2010 - 6/2010	Wet	B
		MH152	North	3	4/2010 - 6/2010	Wet	B
		MH178	North	3	4/2010 - 6/2010	Wet	B
		MH226	N. Central	3	4/2010 - 6/2010	Wet	B
		MH356	South	3	4/2010 - 6/2010	Wet	B
		MH369	S. Central	3	4/2010 - 6/2010	Wet	B
		MH434	Parking Lot	3	4/2010 - 6/2010	Wet	B
Sediment Trap Solids	PCBs	MH178	North	10 (11)[e]	8/2005 - 4/2010	NA	C
		MH19C	S. Central	10 (10)[e]	8/2005 - 4/2010	NA	C
		MH221A	N. Central	7 (11)[e]	8/2005 - 4/2010	NA	C
		MH229A	N. Central	6 (11)[e]	8/2005 - 4/2010	NA	C
		MH356	South	6 (11)[e]	8/2005 - 4/2010	NA	C
		MH363	North	10 (11)[e]	8/2005 - 4/2010	NA	C
		MH364	S. Central	6 (11)[e]	8/2005 - 4/2010	NA	C
		MH422[c]	Lift Station	7 (11)[e]	8/2005 - 4/2010	NA	C
		MH492	South	10 (10)[e]	8/2005 - 4/2010	NA	C
Whole Water	PCBs and TSS	LS431	Lift Station	10	10/2009 - 6/2010	Wet	B
				2	2/2010 - 6/2010	Dry	B
		MH108	North	10	10/2009 - 6/2010	Wet	B
				2	2/2010 - 6/2010	Dry	B

Notes

[a] Continuous flow measurements were recorded at 1-minute intervals at LS431 and 15-minute intervals at MH108 (SAIC, 2010c).

[b] Technical issues prevented data collection at MH108 during September and October 2009. Since little data were collected during the month of July and no data during August, the dry season base flow estimates are thought be biased high (SAIC, 2010c).

[c] Sediment trap solids from MH422 are assumed to also represent LS431 (Landau, 2010b) although it should be noted that drainage at MH422 does not include the south-central or south lateral storm drain lines, which represent about 60 percent of the flow to the lift station.

[d] Data sources represented as A: SAIC, 2010c; B: SAIC, 2010a; and C: Landau 2010b (includes City of Seattle data for MH19C (aka MH477) and MH492.

[e] The first number is considered the "usable" number of samples that were reported as dry weight and are assumed to be comparable with the dry weight interim goals. The number in parentheses is the total number of samples reported (includes both "as-delivered" [or wet-weight] and dry weight samples).

3.3 Runoff Volume and PCB Load Estimates

Figures 7 and 8 show the median[2] PCB concentrations for sediment trap and filtered solids samples, respectively. Each data point represents the median of data collected between 2005 and 2010 (approximately 3 to 11 samples per location). Solids concentrations in the NBF storm drains have been dropping over time as a result of source controls, therefore PCB loading calculations used elsewhere in this report rely primarily on most recent sediment trap solids concentrations.

As shown in Figure 7, dry weight sediment trap solids concentrations from upstream of the North lateral are lower (MH178 median = 0.35 ppm) than concentrations from sediment trap solids from the downstream end of the North laterals (MH363 median = 43 ppm), suggesting that sources from areas downstream/on-site appear to be a cause of sediment enrichment (Landau, 2010b). A similar trend is observed for the North-Central lateral. The highest median sediment trap PCB solids concentration is measured in the North lateral.

The more recent filtered solids results shown in Figure 8 illustrate a similar trend. The filtered solids PCB concentrations along the main line of the North lateral increase in a downstream direction from 0.59 ppm at MH178 (furthest upstream sample location in the North lateral), to 2.9 ppm at MH152, to 4 ppm at MH108 (furthest downstream sample location in the North lateral).

In order to assess where the LTST system should be sited, rough average annual wet weather runoff volumes were computed for each on-site and off-site drainage area (SAIC [2010c] drainage areas used) as delineated on Figure 5 using the rational method.

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[2] Statistic was selected to best illustrate "typical" concentrations.

Rough average annual wet weather PCB loads were then estimated using these runoff volumes, the average wet weather TSS concentration (27.4 mg/L) measured in the whole water samples collected at LS431 (SAIC, 2010a), recent sediment trap PCB solids concentrations (Landau, 2010b), and average whole water PCB concentrations (SAIC, 2010a). Table 3 summarizes the estimated on-site and off-site runoff volumes and water and solids PCB loads for each NBF lateral drainage area[3]. An average annual precipitation value of 36 inches[4] was used based on the King County Surface Water Design Manual (King County 2009), drainage area values for impervious areas were taken from the recent Draft SAIC contaminant loading memo (2010c), and a rough imperviousness-runoff coefficient relationship (Schueler, 1987).

Calculated average annual PCB wet weather loads are shown in Table 3 and Figure 9. These loads are intended to be rough order of magnitude values only, for general drainage area loading comparison purposes. Base flow loads were taken directly from SAIC's loading memo (2010c) and are shown in Figure 10. Several key observations are derived from these loading estimates, as follows:

1. Wet weather PCB loads from off-site areas are a small but consequential fraction of the overall load to the Slip. Off-site area loads are estimated to be an average of 5.0 g/year. This is less than the on-site contribution but still accounts

[3] Mean values were used for load calculations because this is considered a more appropriate central tendency statistic to use for mass balance-based purposes; however median values are shown in Figures 7 and 8 because this is considered a more appropriate central tendency statistic to represent "typical" concentrations, particularly for non-normally distributed datasets (which is typically the case for stormwater quality data).

[4] Geosyntec's estimated average annual runoff volumes (Table 2) at the North lateral and lift station are 18-19% less than SAIC's predicted wet weather runoff volumes (Table 3, SAIC, 2010c) since SAIC used the 2009/10 rain depth of 43 inches and Geosyntec used an average annual rain depth of 36 inches (16% less). Both runoff volume estimates are likely high given SAIC's *measured* runoff coefficients for the north lateral and lift station (derived from the slopes of Figure 3 of SAIC's recent data summary report [2010a], divided by drainage areas). Geosyntec's estimated runoff coefficients (including off-site areas), which are comparable with SAIC's predicted runoff coefficients, are 0.69 and 0.76 for the north lateral and lift station drainage areas, respectively, while SAIC's measured runoff coefficients are 0.42 and 0.62, respectively. This may result in a significant overestimate of wet weather PCB loads from the lift station drainage areas, and particularly so from the north lateral drainage area (which we estimate to be 21% of the wet weather runoff volume at the lift station, compared with a measured value of 15% [SAIC, 2010c]).

for approximately 23% of the total summed load for all areas tributary to the lift station. Furthermore, sediment trap solids from most of the off-site lateral sampling locations exceed the EPA LTST Interim Goal for solids (0.1 ppm). With all off-site runoff possibly re-routed around NBF, the average PCB load at the lift station would decrease from the estimates provided in Table 3, although the new average lift station solids concentration may *increase* because concentrations in upstream off-site solids are generally somewhat lower than downstream solids resulting in higher post-bypass downstream solids concentrations. More importantly however, off-site sediment trap solids-based PCB loads are tremendously uncertain given that they are based on single recent sediment trap solids concentration measurements, uncertain drainage area boundaries, uncertain/uncalibrated runoff volumes/flow rates (measurement of flows at the upstream end of the north-central, south, and south-central laterals is difficult due to their locations in the flight line), and have no water and very limited filtered solids (MH178 only) concentration measurements for comparison. This is recognized as a significant data gap as we consider the effects of re-routing off-site flows on downstream PCB concentrations in water and solids.

2. Significant uncertainty remains with the on-site PCB mass balance. For example, estimated solids concentration-based loads don’t match water concentration-based loads, particularly at the lift station. Water-based loads are likely more accurate given that measured water concentrations are more robust, especially when compared with sediment trap solids data where only one datapoint is available for 2010. These water concentrations are also inherently more useful for total PCB loads estimation than the sediment trap solids concentrations because the whole water measurements include all of the PCB mass in the water column (i.e., both the particulate and dissolved/colloidal fractions), and the water sample sizes are relatively good (n = 10 for wet weather samples). Furthermore, the water concentration measurement methods use flow-weighted average compositing which is considered state-of-the-practice for stormwater monitoring and as such should provide reliable approximation of the event mean concentrations. In addition, all the solids-based loads assume a single total suspended solids (TSS) concentration that is based on the mean flow-weighted average TSS concentration measured at the lift station (27.4 mg/L); this was necessary because TSS data are not available for most laterals. Finally, in multiplying PCB solids concentrations by TSS

concentrations to compute solids-based loads, there is an acknowledged weakness in that the solids measurements reflect one particle size distribution (in this case reflecting sediment trap solids) and the TSS measurements reflect another particle size distribution (reflecting lab filtered solids using a 1.5 um pore size filter).

Furthermore, sediment trap solids-based load estimates are highly uncertain given various data quality and sample representativeness issues including: some older data were deemed unusable because solids analyses were conducted "as delivered" (i.e., wet weight) rather than based on dry weight; backwater (from the lift station vault) conditions in the south, south central, and north central laterals may result in non-representative sediment trap data in these lines (whereas North lateral traps reflect flowing water conditions); and no sediment trap data are available at the lift station so MH422 data are used instead. This latter issue results in an overestimate of lift station loads (reported as 94 g/yr in Table 3) since the diluting affects of the south and south central lines are not considered.

Therefore, estimated filtered solids-based loads are likely more accurate than sediment trap-based loads since the former result in a closer mass balance at the lift station, their measured particle size distributions (PSDs) are likely more representative of NBF storm drain suspended solids (i.e., they demonstrate greater mass percentages of clays), and the 2010 datasets are more robust (i.e., greater sample sizes). However, despite this likely greater accuracy, the measured base flow loads (both solids and water-based) from the North lateral (at MH108) are significantly greater than the measured loads downstream at the lift station (Figure 10, values taken from SAIC, 2010c), which is unexpected and can possibly be explained by a combination of uncertainty in the base flow data (e.g., only two base flow filtered solids and water sampling events have been conducted) and problems with the collection of solids data, as discussed above.

Additional future data collection should help to reduce or resolve some of these sources of uncertainty, however much will undoubtedly remain through the LTST design period.

3. The North lateral comprises a significant, but uncertain, fraction of summed on-site loads. Based on results shown in Table 3, the full (on- and off-site) North lateral area is estimated to contribute 55% and 72% of the summed load at the

lift station during wet weather based on sediment trap solids and filtered solids concentrations, respectively (Figure 9). The 72% filtered solids estimate becomes 94% if the measured lift station load (30 g/yr) is used. Based on water concentrations, the North lateral is estimated to contribute 38% of the wet weather lift station load. And during base flow conditions, the full north lateral is estimated to contribute greater than 100% of the total lift station load based on both filtered solids and water concentrations (Figure 10). Consistent with these findings, Figure 5 of the Draft SAIC PCB loading memo (SAIC, 2010c) shows the North lateral as a percent of the total average annual lift station load (i.e., sum of stormflows and base flows), with results ranging from 32% (based on water concentrations) to 74% (based on solids). Therefore, significant uncertainty remains regarding the north lateral PCB load contribution at the lift station, and as a result we can’t say at this preliminary stage (without additional monitoring data, such as STST performance data collected at the lift station) whether treatment at the North lateral, combined with source controls and bypass of off-site flows, would likely be sufficient to meet the water and solids Interim Goals.

Table 3. Annual Average Wet Weather PCB Load Estimates for Onsite and Offsite Drainage Areas

	Lateral	Annual Runoff Volume				PCBs in Solids (Sediment Trap Data)		PCBs in Filtered Solids		PCBs in Water[h]	
		Area[a]	Imp[a]	RC[b]	Volume[c]	Conc.[d]	Load[e]	Conc.[f]	Load[g]	Conc.[i]	Load[j]
		acres	%	--	ac-ft/yr	mg/kg	g PCB/yr	mg/kg	g PCB/yr	µg/L	g PCB/yr
Off-Site	North	45.4	62	0.61	83	0.44	1.2	0.67	1.9	--	--
Off-Site	North Central	42.7	52	0.52	66	0.68	1.5	--	--	--	--
Off-Site	South Central	42.9	50	0.50	64	0.02	0.04	--	--	--	--
Off-Site	South	64.6	79	0.76	150	0.45	2.2	--	--	--	--
Off-Site	Sum	195.6	63	0.62	360	--	5.0	--	--	--	--
On-Site + Off-Site	North	63.6	71	0.69	132	2.6	12	6.37	28	0.058	9.4
On-Site + Off-Site	North Central	57.4	72	0.70	120	1.1	4.5	0.46	1.9	--	--
On-Site + Off-Site	South Central	64.9	71	0.69	130	0.25	1.1	0.67	3.0	--	--
On-Site + Off-Site	South	111.1	89	0.85	280	0.46	4.4	0.52	5.0	--	--
On-Site + Off-Site	3-380	4.7	100	0.95	13	0.32	0.1	0.91	0.4	--	--
On-Site + Off-Site	Parking Lot	6.9	100	0.95	20	0.55	0.4	0.65	0.4	--	--
On-Site + Off-Site	Sum at LS431	301.7	78	0.75	680	--	22	--	39	--	--
On-Site + Off-Site	LS431	301.7	79	0.77	690	4.0[k]	94	1.29	30	0.029	24.8
On-Site	North	18.2	90	0.86	47	--	10	--	26	--	--
On-Site	North Central	14.7	100	0.95	42	--	2.9	--	--	--	--
On-Site	South Central	22.0	100	0.95	63	--	1.1	--	--	--	--
On-Site	South	46.5	100	0.95	133	--	2.2	--	--	--	--
On-Site	3-380	4.7	100	0.95	13	--	0.1	--	--	--	--
On-Site	Parking Lot	6.9	100	0.95	20	--	0.4	--	--	--	--
On-Site	Sum at LS431	106.1	98	0.93	300	--	17	--	--	--	--
On-Site	LS431	106.1	97	0.92	290	--	--	--	--	--	--

Notes

-- Not applicable

[a] Imperviousness values taken from Figure 2 of SAIC loading memo (2010c). Drainage areas from Landau (2010b), Table 1 however, these areas are currently being reviewed and revised by Landau, and revised boundaries may be used in future LTST submittals.

[b] Runoff coefficients based on equation: RC = 0.9×IMP + 0.05 (Schueler, 1987)

[c] Volume computed using rational method, or V = RC*Imp*Area

[d] Solids PCB concentration values shown reflect the most recent sediment trap data (April 2010 for MH356, MH364, MH221A, MH299A, MH363, MH178, MH422 [which was assumed to represent LS431], MH492, and MH19C) or, for the 3-380 and Parking Lot drainage areas which are without sediment trap data, reflect average PCB concentrations from all storm drain structures sampled in the individual lateral in April 2010. All values

shown in this column are consistent with Table 1 from the Landau Short-Term Stormwater Treatment System Work Plan (2010b), with the exception of the Off-Site South-Central and South Laterals which use the most recent (April 2010) City of Seattle data points.

[e] Average annual solids wet weather loads estimated as product of volume, PCB solids concentration (using recent sediment trap results), and TSS concentration (using the average wet weather value measured at the lift station, or 27.4 mg/L), except for on-site loads which are computed as the difference between 'off-site plus on-site' and 'off-site' loads.

[f] Filtered solids concentration values shown are based on mean wet weather measurements (Landau, 2010) (n = 11 at LS431 and North Lateral, n=3 elsewhere). Alternatively, SAIC used volume weighted estimates for PCBs in filtered solids (2010c).

[g] Average annual solids wet weather loads estimated as product of volume, PCB solids concentration (using mean filtered solids value), and TSS concentration (using the average wet weather value measured at the lift station, or 27.4 mg/L), except for on-site loads which are computed as difference between off-site plus on-site and off-site loads.

[h] Water concentration values shown are based on mean wet weather flow-weighted average water column measurements (SAIC, 2010c) (n = 10 wet weather samples)

[i] Average annual total water wet weather loads estimated as product of runoff volume and mean wet weather PCB concentration in water

[j] Data only sufficient for estimating on-site loads at the North lateral

[k] This sediment trap concentration is based on MH422 which represents about 60 percent of the flow to the lift station (does not include the south-central or south lateral storm drain lines). Given that the south and south-central laterals are two of the lowest PCB lines, it is likely that this is a high and unreliable estimate for the lift station load.

3.4 Evaluation of Treatment Needs

3.4.1 Meeting the Water Interim Goals

Based on the SAIC storm drain monitoring dataset (SAIC, 2010a), the 95th percentile water concentration at the proposed point of compliance (the lift station) is 0.073 µg/L during stormflow events and 0.016 ug/L (in this case, the maximum value of just two samples) during base flow. Therefore, an 81% concentration reduction is needed to achieve the water Interim Goal (0.014 µg/L) 95% of the time during storms, and a 13% concentration reduction is needed during base flows (although additional lift station base flow water samples are needed to confirm) [5]. This information, combined with the relatively high base flow load coming from the North lateral (Figure 10), suggests that treatment at this upstream location would consistently result in compliance with the water Interim Goal at the lift station during base flow conditions. However stormflow loading rates are both more variable and more uncertain, and they will likely drive the treatment location selection process. The greater required reduction during stormflow

[5] These required concentration/load reductions become 59% and 0% for stormflow and base flow conditions, respectively, if the marine chronic criteria (0.030 ug/L) is instead used for the Interim Goal.

(81%) could be achieved via downstream treatment at the lift station, or alternatively via treatment of the lateral drainage area(s) with the highest PCB concentrations, beginning with the North lateral. Treatment would be in combination with continued/additional implementation of source controls in all areas.

One way to evaluate whether the lateral treatment approach would achieve the required reduction is by looking at load contributions from each lateral, as reported in the Draft SAIC loading memorandum (SAIC, 2010c) and as discussed in the previous section of this report. While the total loads from the North lateral are by far the greatest, there is significant uncertainty in the North lateral contributions to the total load at the lift station. Values range from 27-87% (from Figure 5 of the SAIC loading memo [SAIC, 2010c]) depending on whether water or solids (and TSS) concentrations are used. Therefore, it is unclear whether treatment (even at very high levels of removal) of the North lateral drainage area alone would consistently achieve the water Interim Goal at the lift station during wet weather. STST performance monitoring at the lift station should provide valuable data needed to answer this question; preliminary results from water samples collected in November 2010 indicate varying PCB concentrations and support the need for continued data collection. In addition, the effect of recent, ongoing, and planned source controls is difficult to predict, but may be observed through continued monitoring. A recommended LTST system type and location, as well as the water concentration reductions expected at the point of compliance, will be provided to the EPA in the next required LTST submittal, the draft Pre-Design Technical Memorandum.

3.4.2 Meeting the Solids Interim Goals

Based on initial STST influent/effluent sampling results, the Chitosan-Enhanced Sand Filtration (CESF) Active Treatment System (ATS) has been very effective at reducing PCB concentrations in water and removing solids at the North lateral[6]. Water and solids sampling at the lift station began in November; as more results become available we should learn whether treatment at the North lateral consistently results in the achievement of the required water and solids concentration reductions at the lift station.

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[6] Influent and effluent filtered solids and water samples have been collected at the STST system, and have indicated significant removal of total PCBs and TSS in water. Effluent filtered solids samples have been difficult to collect due to the very small amount of suspended solids in the treated effluent.

This data will also provide information on the effect of recent and ongoing source control measures throughout the site; the data will not however capture the effects of new planned source controls or of offsite flow re-reouting.

Compliance planning for the water versus solids Interim Goals is fundamentally different because water treatment at one point in a drainage network results in downstream water concentrations that reflect the blending of treated and untreated flows, whereas solids treatment (i.e., removal of solids at the point of treatment) results in downstream solids concentrations that wholly reflect untreated solids concentrations. Therefore, the current solids Interim Goal (0.1 ppm total PCBs) inherently requires water treatment to remove solids at the point of compliance (since all NBF laterals are known to consistently contribute solids above this level, and may continue to do so even after implementation of robust source controls) unless a new value is permitted, such as the Landau-proposed value of 0.42 ppm that is based on site-specific sediment organic carbon levels, or an EPA-approved AKART analysis concludes otherwise.

The fact that all NBF laterals exceed the 0.1 ppm solids Interim Goal is to be expected given that other typical urban and industrial storm drains in the region are also known to consistently exceed this value (Windward, 2007), and storm drain studies in other regions similarly demonstrate solids concentrations that consistently exceed this value (SFRWQCB, 2008). Furthermore, it is expected that even the treated LTST system effluent may also exceed the solids Interim Goal if a sufficient (analyzable) mass of filtered solids can be collected in the effluent, since this solids mass will be comprised primarily of the smallest particles, which are expected to have PCB concentrations roughly comparable to the bulk suspended solids concentrations based on PCB fractionation literature reviewed (e.g., Schorer, 1997). The biggest challenge that this Interim Goal presents is that treatment, which will always be more effective at removing larger solids, may result in an increase or no change in the post-treatment effluent filtered solids PCB concentrations. This is one of the issues that the AKART analysis will consider. Preliminary effluent filtered solids results from the STST system – a sampling effort that required the filtration of tens of thousands of gallons of water before a sufficient mass of solids had accumulated on the filter bag – support this prediction that the solids Interim Goal may indeed be unachievable, despite an extremely low PCB and solids mass load in the treated effluent. Additional data collection will continue to further evaluate this issue.

3.4.3 Treatment Type and Location Selection Process

Table 4 qualitatively illustrates the relative water quality benefit (defined here as total PCB load reduction), cost, and "sustainability" (or energy/carbon savings) associated with natural and active treatment alternatives at each of the North lateral and lift station locations. The decision-making process with respect to where and how to treat NBF runoff will be heavily dependent on each of these three critical factors. The AKART report will quantify these costs and benefits to allow a comprehensive evaluation of Natural Treatment System (NTS) alternatives[7] with the current ATS technology, to facilitate the selection of a suitable type of treatment (or the *rows* in Table 4, which compare treatment technology type) that will meet the AKART definition. Similarly, the STST monitoring data at the lift station will provide valuable data for the selection of a suitable location of long-term treatment (or the *columns* in Table 4, which compare treatment technology locations), which will then be described and evaluated in the Draft Pre-Design Technical Memorandum that is due to EPA in February 2011. The AKART report will also provide information regarding the costs and benefits of these treatment location options.

[7] NTS alternatives potentially capable of meeting the water and solids Interim Goals will be identified, described, and evaluated in the AKART report.

Table 4. Treatment Type and Location Decision Matrix (Relative Cost indicated by "$", PCB Load Reduction by "💧", and Sustainability (Energy/Carbon Savings) by "☼")[8]

Treatment Type/ Location	North Lateral	Lift Station
Natural Treatment System (NTS)	$ 💧 ☼☼☼☼	$$$ 💧💧💧 ☼☼☼
Active Treatment System (ATS)	$$ 💧💧 ☼☼	$$$$ 💧💧💧💧 ☼

Active treatment at the North lateral (i.e., the bottom left cell in the above matrix) represents the current STST system. Natural treatment, per acre or cfs treated, is generally less expensive (i.e., lower capital and operating cost over the long-term) and requires less energy/carbon input, making this alternative preferable if Interim Goals can be met at the point of compliance. However, on a PCB load reduction basis, treatment of the North lateral alone is expected to provide less benefit than treating all runoff to the lift station (which would also include runoff from the North lateral). Therefore, unless lift station monitoring results during STST implementation indicate that the current water and solids Interim Goals (or possibly the proposed values that will be under consideration) are consistently met as a result of treatment at the North lateral, this work plan proposes evaluation of treatment at the point of compliance (the lift station), combined with source controls, to maximize likelihood of compliance. Another factor that will need to be considered is the anticipated water quality changes that will result from bypass of offsite flows. These various factors will be considered as part of the Pre-Design Technical Memorandum that is due in February 2011.

3.5 System Lifetime

The LTST plan is to meet the water and solids Interim Goals at the point of compliance, as feasible, through treatment of the North lateral or at the lift station, combined with strategically-sited source controls and re-routing of upgradient off-site storm drain flows. Regardless of treatment type (natural or active treatment) or treatment location (North lateral or lift station), Boeing is committed to operate and maintain the LTST

[8] Symbology is not intended to reflect the relative costs/benefits to scale.

system to meet the Interim Goals, as feasible, as long as necessary to minimize potential for recontamination of Slip 4 sediments. Therefore, as a fundamental design assumption, the proposed LTST system will be designed with a design life of approximately 20 years. This very rough value was selected based on an assumed time that is required to control the majority of PCB sources to the NBF storm drain system.

4 DESIGN STORM

The LTST system will be sized at a minimum using one of the following design storm methods, with preference for the latter (most robust) approach:

- **Western Washington Manual**: The Stormwater Management Manual for Western Washington (Ecology, 2005) states the design storm shall be a 24-hour storm with a return frequency of 6 months. The depth of this design storm may be determined either through local data or by multiplying the 2-year, 24-hour storm by as factor of 0.72. The 2-year, 24-hour storm depths are provided by an isopluvial map in Appendix 1-B of Volume I of the manual. The 2-year, 24-hour storm according to this map is 2.00 inches (Attachment A). Therefore, the stormwater design storm depth using the Western Washington Manual at the site is 1.44 inches. This depth would be converted to a design volume or flow rate using a single event model, such as the Soil Conservation Service Unit Hydrograph (SCSUH) or the modified rational method (Ecology, 2005). [9]

- **Depth specified in the ASAOC SOW**: Attachment C-1 of the ASAOC SOW indicates that the 6-month design storm depth is 1.08 inches. This depth would be converted to a design volume or flow rate using a single event model, such as the Soil Conservation Service Unit Hydrograph (SCSUH) or the modified rational method (Ecology, 2005)[5].

- **Continuous Simulation**: A continuous simulation hydrologic model (e.g., Western Washington Hydrology Model [WWHM] or the USEPA's Storm Water Management Model [SWMM]) would be used to determine a treatment system size based on a value at or below which 91% of runoff will be treated, consistent with guidance provided in the Stormwater Management Manual for Western Washington (Ecology, 2005).

[9] This method is only available for wetpool facilities (Ecology, 2005), other facility types will likely require a continuous simulation.

5 PHYSICAL ACTIONS AND BMPS FOR SOURCE CONTROL

As PCB sources have been identified through field investigations and monitoring studies, Boeing has implemented removal and cleanup actions at the NBF in an effort to eliminate the discharge of hazardous materials. In general, these source control efforts have included regular pavement sweeping, installation and maintenance of storm drain inlet filters, storm drain cleaning, storm drain replacement/repair, storm drain sealing/grouting, contaminated soil removal, joint compound removal, abatement of PCB containing paint, and extensive sampling of building materials, surface debris, joint compounds and storm drains in order to identify potential sources of PCBs and other hazardous materials. Some source controls have been implemented as recently as this fall, but sufficient data is not yet available to properly evaluate the impacts on discharge water quality. As additional data is collected, the impact of these recent source controls will be considered as the treatment facility design progresses.

5.1 Recent Source Control Actions

The following physical actions and source controls have already been completed or were in progress as of October 2010, as partially summarized in the STST Work Plan and November 4 Progress Report (Landau, 2010b and 2010d):

- Regularly sweeping flight line areas and other site paved areas;
- Removing accumulated solids from storm drain structures and piping throughout the NBF site through pipe jet-cleaning and storm drain structure vacuuming;
- Sealing storm drain structures with grout to eliminate or minimize groundwater infiltration into the storm drain system within areas of suspected soil contamination;
- Installing the chitosan enhanced sand filtration system (STST system) to operate until the LTST system is installed and operational;
- Placing catch basin filters in storm drain structures in the vicinity of the 3-302, 3-322, and 3-323 buildings to collect debris that enters the storm drain system from ground surfaces;
- Removing PCB-contaminated soil, asphalt, or debris within the 3-322 building area;

- Replacement of a storm drain systems near the 3-302 and 3-323 buildings and excavation of associated PCB containing soil;

- Abatement of PCB-containing caulk, foam, and paint identified during the Propulsion Engineering Labs (PEL) area source evaluation investigation;

- Investigation of PCBs and metals detected in North lateral storm drain structures through the collection and analysis of paint, caulking, insulation, roofing materials, siding materials, and debris; and

- Evaluation of additional potential sources in other parts of the NBF property.

5.2 Continuing Source Control Actions

While the North lateral drainage area has been recommended for long-term treatment (location and type to be determined), other source control actions will continue to be performed, and new source control actions will be identified as needed. This effort will be implemented as summarized below, as the collective effects of site-wide recent, ongoing, and planned source controls may change the level of long-term treatment necessary to meet the water and solids Interim Goals. Planned source control efforts and tentative timelines are as follows (Landau, 2010d):

- ***PCB Paint Abatement.*** Abatement of PCB-containing paint on pipe bollards with PCB concentrations greater than or equal to 50 mg/kg identified during the North Lateral Source Evaluation sampling events was completed in October 2010. Additional PCB-containing paint will be removed in the spring/summer of 2011 when the temperatures are again high enough for the paint removal product to be effective. A procedure for using wipe sample results to identify PCB-containing paint for abatement is being developed. **Completion expected in spring/summer 2011.**

- ***Human Health Risk Assessment and Transport Evaluation of PCBs in Concrete Joint Material***. A human health risk assessment and fate and transport analysis will be conducted during 4Q 2010 for remaining PCB containing joint compounds to consider all relevant exposure pathways and to determine if there is a risk to be mitigated. If the risk assessment determines that there is a risk of exposure to human health, or if PCBs are likely to result in an exceedance of the Sediment Quality Standards, then actions will be taken to mitigate the risk. 125 concrete joint material samples, 100 wipe samples, and 8 air samples have been collected and analyzed. About 25 storm drain locations will be sampled for solid material in 4Q 2010. **Completion expected 1Q 2011.**

- ***Soil and Groundwater Investigation.*** Investigation of soil and groundwater in the PEL area of NBF. Collected approximately 420 soil samples from 109 sample locations. Four groundwater monitoring wells were installed and sampled in the focused soil excavation area. Additional groundwater monitoring wells to be installed during 4Q 2010. **Completion expected January 2011.**

- ***GTSP/NBF Fenceline Soil Excavation***. Planning for soil excavation and utility re-routing during 2010 and 1st/2nd Qtr 2011, excavate soil during 3Q 2011 (during lowest water table). **Completion expected August 2011.**

6 REMOVAL ACTION AND CONSTRUCTION ACTIVITIES

The LTST removal action team and contractor selection process are described below. Areas requiring clarification and anticipated problem areas are also discussed in an effort to mitigate potential issues early in the process.

6.1 Removal Action Team

The LTST Removal Action team is led by staff from Boeing, with assistance from consultants Geosyntec and Landau Associates, and is anticipated to consist of additional subcontractors that have yet to be selected. The overall project is managed by Boeing, under the authority of USEPA. An organizational chart (Figure 11) lists specific project personnel and their roles and responsibilities within each agency or firm.

6.2 Contractor Selection Process

Analytical Resources Inc. has been chosen for the analytical laboratory. However, one or more analytical laboratories may be selected as needed for processing water quality and sediment samples. Other contractors include a surveyor to identify site boundaries, topographic contours, and infrastructure elevations, a locator to identify existing utilities, a botanical consultant to advise on planting and seeding requirements for a Natural Treatment System (if applicable), and one or more contractors to construct the LTST system(s). The need for types of specific contractors will be established during the pre-design process. Contractors will be selected based on qualifications (i.e., experience, quality of product, etc.), ability to meet Boeing contract terms and conditions, submitted bid cost, and ability to provide services or products in a timely manner (i.e., ability to meet project schedule).

6.3 Areas Requiring Clarification or Anticipated Problem Areas

The following areas require clarification or are anticipated problem areas that could impact the LTST system design and/or schedule:

- ***Performance standards***. The water and solids Interim Goals are subject to change pending the results of the proposed Salinity Monitoring Study, AKART Analysis, and the collection of other monitoring data. While the preliminary design of the LTST facility will use the current Interim Goals as design objectives, the performance standards may affect one or more aspects of the design, including both the locations and types of controls. In an effort to mitigate late design changes, preliminary studies will be proposed and carried out as soon and as efficiently as possible, providing data to support the LTST design early in the process.

- ***Short-Term Stormwater Treatment system performance***. The STST system is currently treating stormwater from the North lateral and is planned to continue operating until the LTST facility is constructed and operating, or before September 30, 2011. As noted in the ASAOC SOW, the LTST facility will be designed, in part, based on the data collected during operation of the STST facility. Collecting performance data such as influent and effluent water and solids PCB concentrations, TSS, turbidity, and particle size distribution at the STST facility as well as water and solids PCB concentrations at the lift station (to see how North lateral treatment affects PCB concentrations downstream), while simultaneously designing the long term system, creates a moving target. To avoid last minute design changes to the extent possible, STST data collected early in the design process will be reviewed and assumed representative. As the design progresses, critical STST results will be reviewed periodically to identify any major issues affecting the LTST design.

- ***Source controls.*** The impact of source controls currently being implemented and planned/proposed at the site should reduce PCB concentrations in water and solids at the lift station, although these impacts have not yet been quantified through monitoring. The water quality and storm drain solids data summarized in this Work Plan does not reflect these recent activities. To be conservative, the LTST system will be designed to meet the performance standards based on available water and solids monitoring data, with an emphasis on the most recent data. As the impact of source controls are quantified, the design will be reevaluated in the context of the new data.

- ***Re-routing Off-site Runoff.*** Boeing will consider re-routing one or more laterals at the upgradient property boundary. The preliminary draft rerouting plan (subject to change) for the County lateral is shown in Figure 12. The impact of this wet and dry weather flow bypass on downstream water and solids concentrations at the lift station, combined with implementation of treatment (short- and long-term) and source controls, is a significant uncertainty. Without a reliable PCB mass balance on the NBF storm drain system, these effects are very difficult to predict and assumptions will have to be made based on available monitoring data.

- ***Data gaps***. The limited quantity of recent monitoring data at specific locations within the NBF storm drain system (including at the upgradient property boundary) is a source of uncertainty for estimating population statistics for PCBs in water and solids, as well as for estimating the compliance likelihood for treatment and source control at various lateral drainage areas. In particular, flow-weighted composite water sampling at each of the laterals, upgradient and downgradient of the site and during both storm and base flows, is lacking as existing water data are limited to MH108 and LS431; such data would also inform the PCB mass balance at the lift station as this remains a source of uncertainty for treatment planning. Sediment trap solids PCB data are highly uncertain/limited given backwater effects in some of the laterals, older data that were based on solids wet weight, and a lack of measurements at the lift station. Drainage area boundaries, the re-routing plan for off-site storm drain flows (e.g., whether some or all upstream laterals will be re-routed), and runoff flow rates and volumes are also continuously being refined, contributing to the uncertainty for the LTST design. Continued flow monitoring (to increase the period of record and broaden the variety of storms captured) in the North lateral and at the lift station is also essential for hydrologic model calibration, which will be necessary for sizing the LTST system. Similarly, discrete storm and base flow measurements at the laterals near the upgradient property boundary are lacking; such data would also be valuable for calibrating a hydrology model as well as for designing any off-site bypass diversion weirs.

  While the existing monitoring datasets will serve as the basis of design for the LTST system, additional data collected for special studies (e.g., source control investigations, Salinity Monitoring Study, STST Sampling and Analysis Plan, SAIC/Ecology data gap studies, etc.) and other investigations will be evaluated in combination with the current datasets. Perhaps most importantly however, the collection and review of water and solids data at the lift station (i.e., the proposed LTST compliance point) – *while the STST system is operational* – will be critical for determining whether LTST at the North lateral may be sufficient to meet the water and solids Interim Goals.

- ***Schedule***. The ability of the Removal Action Team to submit deliverables as scheduled is dependent on a timely EPA review, which is assumed to be two (2) weeks for each draft and final submittal. In addition, every effort will be made to secure qualified, reliable, efficient contractors that are able to meet the ASAOC deadlines.

6.4 Local, State, and Federal Regulations and Standards

The LTST facility will be designed, permitted (or meeting the substantive requirements of the permits), and constructed in compliance with local, state, and federal regulations and standards. Any necessary permits will be identified in the Pre-Design Memorandum. Excavated materials will be tested to ensure proper disposal.

7 SCHEDULE OF ACTIVITIES AND DELIVERABLES

The ASAOC SOW (USEPA, 2010a) includes a project schedule for the submittal of deliverables. Task 1 deliverables are related to the STST facility and are addressed in the STST Work Plan (Landau, 2010b). The Task 2 and 3 deliverables are related to the LTST facility installation and operation, with this Work Plan serving as the Task 2 deliverable. Lastly, Task 4 deliverables will be submitted after the LTST facility is operating. Task 3 and 4 deliverables are described below and presented in Figure 13. It should be noted that while the Salinity Monitoring Plan and AKART Analysis are not explicit Task 3 or 4 deliverables, they are intended to be used as supporting documents which may affect the Interim Goals for water and solids at Slip 4. These documents will also be submitted to the EPA for review.

Deliverables contingent on EPA review are estimated as they assume a two (2) week review period. In order to expedite the schedule, tentative EPA design review meetings are scheduled to occur soon after the submittal of draft deliverables.

7.1 Task 3 Deliverables

Task 3 deliverables, as specified in the ASAOC SOW, cover the design, installation, operation, and maintenance of the LTST facility(s) are described below.

Task 3A.1. Pre-Design Technical Memorandum

Draft Deliverable Date:	February 22, 2011
Estimated Final Deliverable Date:	March 23, 2011 (within 15 days from receipt of EPA's comments on the Draft Technical Memorandum)

The Pre-Design Technical Memorandum will include design performance specifications and project goals to verify the project concept and direction for the long-term treatment facility(s). The memorandum will address:

- Proposed long-term treatment facility(s) and the use of contractors; proposed treatment processes and devices (e.g., treatment units, filters, storage tanks), including a discussion of drainage basins, environmental conditions, rainfall amounts and intensities, system efficiency and discharge water quality;

- Bypass or overflow events;

- Process and instrumentation drawing for the system showing all flows and including any regeneration and/or backwash;

- Preliminary design including size and alignment of infrastructure and improvements;

- Management/maintenance plan to operate the facility, with an estimate of annual maintenance costs; and

- Monitoring and contingency planning, including how data will be recorded and reported to EPA.

Task 3A.2. Pre-Final (60%) Design Document

Deliverable Date: Week of April 25, 2011

The 60% design documents will provide the design criteria and the basis of design for the removal action per the information provided in the Pre-Design Technical Memorandum. The following are examples of the types of information to be included:

- Technical parameters and supporting design calculations;
- Description of the analyses conducted to select the design approach, including a summary and detailed justification of design assumptions and verification that design will meet performance standards, and the methods used to measure compliance with measurement quality objectives (such as performance and method requirements);
- Relevant information from Task 3.A;
- Details of the treatment system (e.g., the conveyance system, oil-water separators, storage system, transfer system [including pumps], sedimentation system, filtration system, granular activated carbon system, backwash system);
- Procedures and plans for the decontamination of equipment and the disposal of contaminated decontamination materials;
- Construction plans/drawings/sketches and required technical specifications; proposed locations of processes/construction activities; and
- Construction schedule.

In addition, the 60% design document will include identification of, and rationale for, sampling compliance point comparison to Interim Goals for solids and water, including a discussion of how downstream inputs will be considered. A Sampling and Analysis Plan (SAP), comprised of a Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP), will also be included for the long-term stormwater treatment removal action. The SAP will meet the requirements as outlined in Section III of the ASAOC SOW.

Task 3A.3. 90% Design Documents

Deliverable Date:	Week of May 23, 2011

The 90% design documents will include design sheets, specifications, a cost estimate, and a construction schedule and any revised elements of the 60% submittal.

Task 3A.4. 100% Design Documents

Deliverable Date:	Week of June 20, 2011

The 100% design document will include the final design sheets, specifications, cost estimate and construction schedule. The construction documents will be prepared to allow the construction of the proposed treatment facility(s).

Task 3B. Operation and Maintenance Manual

Draft Deliverable Date:	Week of May 23, 2011
Final Deliverable Date:	Week of June 20, 2011

A draft and final operations and maintenance (O&M) manual will be prepared for the constructed treatment system. The O&M manual will include guidelines for operations and maintenance of the treatment system to meet project objectives and applicable state and federal water quality standards. An emergency prevention and contingency plan will also be included in the O&M manual.

Task 3C. Monitoring Plan for Water and Solids in Influent and Treated Effluent

Draft Deliverable Date:	June 1, 2011
Estimated Final Deliverable Date:	June 30, 2011 (within 15 days from receipt of EPA comments on the Draft Monitoring Plan)

A Monitoring Plan will be prepared to detail the collection, analysis, and how data elements deemed essential to characterizing the discharge of treated water from NBF to Slip 4 will be reported. The Monitoring Plan will establish a consistent set of methods and procedures to be followed during the sampling and analysis of water and solids in influent and treated effluent (stormflow and base flow) to ensure that data relating to the efficacy of the treatment system is valid. The Monitoring Plan will be consistent with the SAP, FSP, and QAPP as well as Attachment C-1 of the ASAOC SOW, which specifies the methodology and minimum number of samples for each data need. At minimum, the Monitoring Plan will include:

- Purpose and objectives;
- Sample event criteria and parameters;
- Sample collection and processing procedures (e.g., stormwater grab samples from storm events, flow-weighted composite whole water stormwater samples from storm events; dry-weather grab samples from base-flow events; and/or automated data and manual data monitoring and storage for treatment system);
- Analysis by particle size fraction;
- Storm qualification criteria;
- Stormwater sample collection procedures;
- Sample analysis procedures;
- Equipment decontamination procedures;
- QA/QC;
- Data analysis and reporting; and
- Schedule.

7.2 Task 4 Deliverables

Task 4. Removal Action / Stormwater Treatment Completion Report

Estimated Draft Deliverable Date:	November 14, 2011 (within 45 days of completion of all work required by ASAOC and SOW, including receipt of all final laboratory data)
Estimated Final Deliverable Date:	December 19, 2011 (within 20 days from receipt of EPA comments on the Draft Completion Report)

In compliance with the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR 300.165, the Removal Action / Stormwater Completion Report will summarize the removal operation and actions taken to comply with the ASAOC. The following sections will be included in the report:

- Introduction;
- Chronology of events;
- Performance standards and cleanup goals met;
- Description of QA/QC procedures followed;
- Description of treatment system and construction activities;
- Final inspection documentation;
- Design and as-built drawings;
- Certification that the treatment system is operational and functional;
- Discussion of operation and maintenance requirements; and
- A summary of project costs.

The final report shall include the following certification signed by a person who directed or supervised the report preparation:

> "Under penalty of law, I certify that to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of the report, the

information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false or misleading information, including the possibility of fine and imprisonment for knowing violations."

7.3 Meetings

EPA design review meetings will be held as required in the ASAOC SOW, with the first scheduled during the week of March 21, 2011, following the submittal of the Final Pre-Design Technical Memorandum. Three additional tentative meetings have been proposed to follow the submittals of the Pre-Final (60%) Design Documents, 90% Design Document and Draft O&M Plan (to be submitted simultaneously), and the 100% Design Document and Final O&M Plan (to be submitted simultaneously). Each working meeting is intended to be cooperative and collaborative in nature, with an open book design to allow for an "over the shoulder" EPA review.

7.4 Other Deliverables and Activities

The following deliverables and activities are not explicit requirements of the ASAOC SOW but are necessary precursors to the deliverables required for compliance with the LTST Removal Action.

Draft Slip 4 Salinity Monitoring Plan

Estimated Draft Deliverable Date: December 6, 2010
Final Deliverable Date: January 14, 2011

The Lower Duwamish River is a tidally influenced river which may have highly variable salinity depending on tidal conditions, flows, and storm water influences. Applicable water quality criteria for Slip 4 are dependent upon the presence and extent of salinity levels within the slip. Demonstrating which criteria, freshwater or marine, are most appropriate may be based on area specific salinity determinations. The salinity monitoring plan will address the applicability of marine or fresh water criteria by collecting discrete vertical profile measurements of salinity and temperature over the course of a full tidal cycle and across a lateral transect midway along the Slip. This transect profiling will occur during three high flow events (based on Green River discharge monitoring) to allow for an assessment during worst case (i.e., low salinity) conditions. Salinity monitoring results will then be compared with the relevant State and Federal salinity triggers to determine whether marine or fresh water criteria apply. The goal is to collect data to inform the selection of an appropriate water Interim Goal before the treatment technology and location are selected.

Draft AKART Analysis and Engineering Report

Draft Deliverable Date: November 29, 2010
Estimated Final Deliverable Date: February 5, 2011

The AKART Stormwater Analysis Engineering Report will be developed to identify effective and reasonable methods of reducing PCBs from NBF storm drain discharges and to recommend a long-term stormwater treatment strategy that can be implemented to minimize the potential for recontamination of sediments in Slip 4. The AKART Report will include a description of the analysis methodology, a summary of existing hydrology and water quality at NBF, an evaluation of cost and expected effectiveness of candidate natural and active treatment strategies, and conclusions and recommendations. The selection of potential treatment strategies will be based on identifying available unit treatment processes capable of removing fine particulates from stormwater while considering the spatial requirements with respect to the physical constraints of the site. Anticipated performance and life-cycle costs (including dollars per gram PCB removed) will be key factors influencing the recommended treatment strategy.

Treatability Sampling, Media Pilot Testing, and Other Data Gap Sampling

Estimated Completion Date: June 6, 2011

Approximately one month into the Pre-Design Technical Memorandum effort, if deemed necessary, treatability sampling, media pilot testing, and/or other data gap sampling may begin and progress for approximately 150 days. This effort is intended to provide critical site-specific treatability data using the LTST process(es) identified in the AKART Analysis and the Pre-Design Technical Memorandum that will be used to refine the design prior to construction and start-up. Treatability testing may include investigations of PCB fractionation, particle size distribution, congener profiles, media PCB removal potential, necessary contact time, time to breakthrough and/or clogging, and/or other sources of uncertainty. Pilot testing may be performed on-site under conditions representative of full-scale implementation (e.g., one option is to split STST system influent flows to allow a side-by-side comparison with one or multiple pilot-scale LTST design alternatives). Data gap sampling, if determined to be necessary, would target stormflow and base flow measurements and/or PCB water/solids concentrations at specific locations to more accurately characterize PCB loading rates in the NBF storm drain system. At a minimum, storm drain monitoring data will be collected consistent with the STST Sampling and Analysis Plan (SAP) for performance and compliance evaluation purposes, and Slip data will be collected as described in the Salinity Monitoring Plan to evaluate the feasibility of using the chronic aquatic life marine criteria as the Interim Goal for water discharged to Slip 4.

Bidding, Contractor Selection, and Construction

Estimated Completion Date: September 4, 2011

The 100% Design Documents, including plans, specifications, engineer's estimate, and a construction schedule will be released for bidding near the end of June. The bidding, contractor selection, and construction process will need to follow an accelerated schedule in order to meet the ASAOC deadline. A construction contractor will be selected as described in Section 3.2 and contract negotiations should be completed by July 19. Mobilization and material procurement should occur in the following week.

Start-Up Testing

Completion Date September 30, 2011

Start-up and shake-down testing will follow the procedures outlined in the O&M Manual and will take place as soon as construction is completed to ensure the LTST system is operating as intended and is able to consistently meet the performance standards. In compliance with the ASAOC, a report will be prepared evaluating the operation of the system and describing problems and resolutions encountered during startup. This report will be submitted to EPA as an Appendix to the Removal Action / Stormwater Treatment Completion Report.

8 SUMMARY OF EXISTING DATA & DATA GAPS FOR STORM DRAIN BASE FLOW CONDITIONS

8.1 Pollutant Concentration Data Summary, Recent Sampling

Monitoring for PCB contamination first began at North Boeing Field in August of 1984 with six samples collected in the drain line near the Georgetown Steam Plant. Since that time numerous activities and sampling events have resulted in the collection of PCB data for the drain line laterals, catch basins, and manholes. A detailed summary of these monitoring activities can be found in the Summary of Existing Information and Data Gaps Supplemental Report (SAIC, 2009a). The supplemental report also details more recent activities, which include a site-wide storm drain assessment and cleanup effort that began in January 2007 and sediment trap sampling that started in August 2005.

Between October 2009 and June 2010, SAIC collected water samples at LS431 and MH108 and analyzed for PCBs, PAHs, metals, chlorinated hydrocarbons, phthalates, phenols, VOCs, sediment grain size, and conventional surface water quality parameters (SAIC, 2010a). Samples at both locations were collected during ten storm events (flow weighted composite samples) and two base flow events (flow weighted composite samples at the lift station and time-weighted composite samples at MH108). At those same locations and during the same events, filtered solids samples were collected and were analyzed for metals, PCBs, PAHs, dioxins/furans, and grain size. During the last three storm events (April 2010 through June 2010), filtered solids were sampled from MH152, CB165, MH178, CB173, MH133, and MH138 in the North lateral storm drain line. During those same three storm events, filtered solids samples were also collected in other storm drain lines at MH434, MH356, MH369, MH226, and CB423. Also, one base flow sample was collected at CB173, a catch basin in the North lateral near the Georgetown Steam Plant fence line.

8.2 Flow Measurement Data Summary

The majority of the NBF site, with the exception of the parking lot area and other minor areas, drains to a vault at the lift station. Lift station LS431 conveys runoff to a higher elevation prior to discharging to Slip 4. Its elevation also prevents rising tidal waters from flowing into the system. Pumping occurs when the water level reaches pre-set levels. Additional pumps are sequentially brought on-line if the water level continues to rise in the lift station during pumping operations. Continuous flow measurements at MH108 and LS431 downstream of the pump were collected over a 9-month period. Based on these flow measurements, SAIC (2010c) estimated wet and dry season annual base flow volumes based on continuous flow data at LS431 and MH108 during precipitation-free periods of at least three days. Data were collected from September 2009 through early July 2010, though technical issues prevent data collection at MH108 during September and October 2009. Since little data were collected during the month of July and no data during August, the dry season base flow estimates are thought be biased high (SAIC, 2010c). Table 5 summarizes SAIC's base flow rate estimates for wet (October 1 through March 30) and dry (April 1 through September 30) seasons, respectively. Based on a review of continuous flow measurements at the lift station, average base flow rates at this location are 0.5 to 1 cfs, respectively. By comparison, base flows in the North lateral at MH108 were reported as 0.14 cfs (Landau, 2010a). This information, along with the data shown in Table 5, suggests that the North lateral contributes approximately 20% of the base flows measured downstream at the lift station.

Table 5. Summary of Annual Base Flow Total Measured Discharge Volumes (ac-ft) (SAIC, 2010c)

Season	North (MH108)	Total (LS431)
Wet	38	180
Dry	20	120

8.3 Summary of Base Flow Data Gaps

As summarized in Table 2 (discussed in Section 3.2), base flow water and filtered solids data are primarily limited to MH108 (representing flow in the North lateral) and LS431 (at the lift station, representing combined upstream flow from the North, North-Central, South, South-Central, and 3-380 building laterals), with just two base flow samples available at each of these locations. While data at these two locations provide some information about PCB baseflow concentrations and loads from the North lateral and lift station drainage areas, they do not provide any such information for the upstream off-site drainage areas, which is of interest as we attempt to estimate the downstream water quality benefits that may result from re-routing off-site runoff. Therefore, a notable data gap in the existing base flow dataset is water and filtered solids PCB measurements at storm drain locations beyond MH108 and LS431. Similarly, flowrate measurements are unavailable for characterizing base flows at the upgradient property boundary; these data are of interest for estimating off-site runoff volumes and PCB loads, and for calibrating a hydrology model for the storm drain system (for use in designing the LTST system and/or the off-site bypass diversion weirs). Such data would also be valuable to better understand the overall NBF water and PCB mass balance, as well as loading rates and sources to the Slip. Load estimates based on existing base flow data are highly uncertain, as Figure 10 shows, where the filtered solids and water-based base flow loads calculated at MH108 are greater than those at the lift station, which should represent the sum of all incoming lateral loads including the North lateral.

9 STORM DRAIN MONITORING

Additional data is needed to fill data gaps to support LTST system planning and design, as well as to meet EPA requirements as described in Attachment C-1 of the ASAOC. These requirements are summarized in Table 6 below. This monitoring effort will occur between November 2010 and summer 2011, and the results will be periodically summarized in NBF stormwater treatment progress reports to the EPA.

Table 6. Summary of Required Verification Sampling of Water and Solids (USEPA, 2010a)

Data Need	Methodology	Measured Total PCB Concentration must be below:	Minimum number of Samples
Solids concentration	In-line filtration	100 ppb dry weight	5 storm events + 2 base flow
	Bed load sampler	100 ppb dry weight	5 storm events, including at least one over 0.5 inches and one 6-month storm (1.08 inches) + 2 base flow
Water concentration	Flow-weighted auto composite	0.014 ug/L (ppb)	5 storm events, including at least one over 0.5 inches and one 6-month storm (1.08 inches) + 2 base flow

The definition of a storm event will be consistent with the definition previously used by Ecology: a 24-hour period with a 0.15 inch or more of rain over a period of at least 5 hours, preceded by at least 24 hours of no greater than a trace amount (0.04 inch) of precipitation (SAIC, 2009b). If actual precipitation is less than 0.15 inches but more than 0.1 inches, the water samples will be run for PCBs and TSS only and filtered solids will be run for PCBs and, if possible, particle size distribution. If precipitation is greater than 0.15 inches then additional parameters will be analyzed (Landau, 2010b). As required by the ASAOC, one sampling event will be during a storm with over 0.5 inches of rain and one sampling event will be during a storm with at least 1.08 inches of rain.

Continued storm drain monitoring is necessary not only to fill data gaps to support LTST system planning and design, but also to characterize runoff in areas not proposed for water treatment. Previous monitoring by SAIC has focused on sampling at locations MH108 (North lateral) and LS431. Monitoring will continue at these locations to build upon existing datasets (and allow for evaluation of temporal trends) and to allow for compliance assessment at the lift station.

The proposed monitoring effort is consistent with the STST Sampling and Analysis Plan (SAP) (Landau, 2010b) and is summarized in Table 7 below (Table 1 from STST SAP).

TABLE 7
SHORT-TERM REMOVAL ACTION SAMPLING AND ANALYSIS SUMMARY
NORTH BOEING FIELD - SEATTLE, WASHINGTON

Location	Sample Type	Sample Media	Frequency (a)	Parameters (q)	Analytical Methods
Lift Station (LS 431)	Whole Water (b, c, p) (flow-weighted composite)	Stormwater (d)	10 Initial Events (5 storm events and 2 base flow under the ASAOC and 3 additional storm events to provide data for Ecology NBF/GTSP RI/FS), Nov 2010 - April 2011	PCBs	EPA Method 8082
				TSS	SM 2540
			To be Determined (e), starting May 2011	PCBs	EPA Method 8082
				TSS	SM 2540
	Filtered Solids (b, q) (in-line stormwater filtration)	Stormwater Solids	10 Initial Events (5 storm events and 2 base flow under the ASAOC and 3 additional storm events to provide data for Ecology NBF/GTSP RI/FS), Nov 2010 - April 2011	PCBs	EPA Method 8082
				TSS	Calculated (f)
				Particle Size Distribution	PSEP-PS
				PCB Concentrations by particle size (m)	EPA Method 8082
			To be Determined (e), starting May 2011	PCBs	EPA Method 8082
				TSS	Calculated (f)
				Particle Size Distribution	PSEP-PS (r)
				PCB Concentrations by particle size (m)	EPA Method 8082
	Bed Load (g)	Residual Solids	5 Storm Events and 2 Base Flow Events	PCBs	EPA Method 8082
Short-Term Stormwater Treatment System	Whole Water Influent (grab)	Stormwater (d)	Weekly (h)	PCBs	EPA Method 8082
				TSS	SM 2540
	Whole Water Effluent (grab)	Stormwater (d)	Weekly (h)	PCBs	EPA Method 8082
				TSS	SM 2540
	Whole Water Effluent (grab) (i)	Stormwater (d)	Weekly (j)	Residual Chitosan	Ecology approved procedure (k)
	Filtered Solids Influent	Stormwater Suspended Solids	Twice monthly (l)	PCBs	EPA Method 8082
				TSS	Calculated (f)
	Filtered Solids Effluent	Stormwater Suspended Solids	Twice monthly (l)	PCBs	EPA Method 8082
				TSS	Calculated (f)
Manhole 108 (MH108) (p)	Whole Water Effluent (b, p) (flow-weighted composite)	Stormwater (d)	5 Storm Events Nov 2010 - February 2011 (h)	PCBs	EPA Method 8082
				TSS	SM 2540
	Filtered Solids (b, q) (in-line stormwater filtration)	Stormwater Solids	5 Storm Events Nov 2010 - February 2011 (h)	PCBs	EPA Method 8082
				TSS	Calculated (f)
				Particle Size Distribution	PSEP-PS (r)
				PCB Concentrations by particle size (m)	EPA Method 8082
Sediment Traps (SL4-T1, SL4-T2, SL4-T3, SL4-T4, SL4-T4A, SL4-T5, SL4-T5A)	Grab	Stormwater Solids	Semi-Annually (n)	PCBs	EPA Method 8082
				Semivolatiles	PSDDA SVOCS SW8270D
				Total Metals	Method 6000-7000
				NWTPH-Dx	NWTPH-Dx
				Total Organic Carbon	Plumb, 1981
				Grain Size	PSEP-PS
Weir tank (filter backwash tank)	Grab	Settled Solids	As Needed (o)	PCBs	EPA Method 8082
				PAHs	SW8270D
				metals	TCLP and/or Method 6000-7000
				Petroleum Hydrocarbons	NWTPH-Dx and NWTPH-Gx

TABLE 7
SHORT-TERM REMOVAL ACTION SAMPLING AND ANALYSIS SUMMARY
NORTH BOEING FIELD - SEATTLE, WASHINGTON

Location	Sample Type	Sample Media	Frequency (a)	Parameters (q)	Analytical Methods

(a) Monitoring plan beginning November 2010. All sampling and analysis will be performed by Boeing/Landau Associates and Boeing's contract laboratory, unless otherwise noted.
(b) Boeing is coordinating with the Washington State Department of Ecology and their consultant SAIC for sampling at the lift station and Manhole 108. Samples may be collected by either Boeing/Landau Associates or Ecology/SAIC.
(c) During three events, Ecology/SAIC will collect whole water samples at the lift station using centrifuge method (Green River) and submit the samples for PCB analysis .
(d) Stormwater is defined as all liquids, including any particles dissolved therein, in the form of base flow, storm water runoff, snow melt runoff, and drainage, as well as all solids which enter the storm drain system.
(e) Boeing will propose to EPA a sampling frequency of monthly or quarterly based on the results from the initial 10 sampling events.
(f) Calculated based on mass of filtered solids and volume of stormwater filtered.
(g) The feasible location(s) for installation and specific type of bed load sampling unit is still being determined.
(h) The five Manhole 108 stormwater and solids sampling events and at least five of the weekly influent/ effluent sampling events will be performed concurrent with the lift station storm sampling events. Whether or not weir overflow occurred (i.e., treatment system bybass) during the sampling period will be recorded.
(i) Whole water effluent grab samples for Residual Chitosan testing will be collected from the treatment facility effluent sample port by Clear Water Compliance Services.
(j) Because of the uniform low turbidity of the NBF stormwater relative to the typical chitosan effluent sand filtration (CESF) construction site projects, the fact that residual chitosan has never been detected in sand filter effluent from this project, and because of the extremely low probability of chitosan passing through the sand filters, residual chitosan is proposed to be conducted weekly.
(k) Per Clear Water O&M Manual, Ecology approves procedures for residual chitosan testing for each distributor of chitosan acetate. Testing will be conducted in accordance with the distributors approved procedures.
(l) The influent and effluent flow rate will be checked twice monthly. If the flow rate is low enough to suggest adequate amount of solids have collected on the filter, a filtered solids sample will be collected and analyzed.
(m) It is expected that there will be adequate quantity of solids for particle size distribution analysis, but there may not be an adequate amount of solids for the laboratory to analyze PCBs within selected particle size fractions.
(n) Sediment traps were installed November 12, 2010. The traps will be collected and replaced in April 2011. Depending on the quantity of solids collected, the laboratory may not be able to analyze all parameters. Analysis of parameters will be prioritized in the order listed.
(o) The thickness of accumulated solids (sludge) in the weir tank will be checked monthly by Clear Water Compliance Services. If more than an average of 12 inches of solids have accumulated a grab sample of the solids will be collected by Boeing/Landau Associates and analyzed for waste characterization purposes. Similar testing would be done of filter sand prior to disposal.
(p) Lift station and Manhole 108 whole water samples will also be analyzed for metals (arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc), SVOCs, and TOC and other conventionals in accordance with the Ecology/SAIC storm system sampling work plan and addenda (SAIC 2009, 2010b, 2010c) if sufficient volume is available.
(p) Lift station and Manhole 108 solids samples will also be analyzed for metals (arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc), PAHs, and dioxins/furans in accordance with the Ecology/SAIC storm system sampling work plan and addenda (SAIC 2009, 2010b, 2010c) if sufficient volume is available.
(q) Analyses will be performed if sufficient sample volume is collected. The priority for analysis of samples if insufficient sample volume is collected is summarized in Table 4.
(r) Grain size fractionation/particle size distribution will be conducted using Puget Sound Estuary Protocols (PSEP) method. When low volumes of sample are collected, grain size fractionation will be accomplished using sedigraph for material less than 62.5 µm.

It should be noted that the sampling effort summarized above exceeds the minimum number of samples required in ASAOC Appendix C-1 (Table 6 of this report). The protocol followed for this monitoring effort will be consistent with the SAIC SAP and Quality Assurance Project Plan (QAPP) (SAIC, 2009b).

In addition to the continued sampling effort described above, as needed, additional monitoring may be conducted to help define PCB loading from the various subareas and/or assess PCB treatability to support LTST system design.

A separate LTST system performance monitoring (post-start-up) effort will be described in the Task 3C Monitoring Plan for Water and Solids in Influent and Treated Effluent. This monitoring plan will be consistent with EPA SAP, Field Sampling Plan (FSP), and QAPP requirements as described in the SOW Appendix C, Section III.

10 DESIGN CHANGES

Boeing shall submit all deliverables as draft and final to EPA for review. It is assumed that the 60% and 90% submittals are draft in nature, with the 100% submittal serving as the final set of design documents. Tentative review meetings have been proposed immediately following 60% and 90% draft submittals. These meetings are assumed to be conference calls scheduled in the same week as the draft submittal. Scheduled and tentative EPA design reviews and meetings are intended to reduce the possibility of last minute design changes by allowing for frequent review and comment. While every effort will be made to avoid unanticipated design changes, in the event that such a change is necessary, EPA will be notified immediately for approval and processing.

11 EPA OFF-SITE RULE COORDINATION

Removal actions requiring the removal of waste from the NBF shall do so in compliance with the procedures outlined in EPA's Off-Site Rule (OSR) (40 CFR 300.440). The OSR specifies that "CERCLA wastes may only be placed in a facility operating in compliance with the Resource Conservation and Recovery Act (RCRA) or other applicable Federal or State Requirements." Criteria contained in the OSR shall be consulted to determine whether facilities are acceptable for the receipt of CERCLA wastes. The off-site status of any facility in question shall be made via email to the Region 10 contact:

Adam Baron
baron.adam@epa.gov
206-553-6361

However, this notice shall not apply to any shipments when the total volume of all shipments will not exceed 10 cubic yards in a calendar year.

Requests for facility information should be made as far in advance as possible (responses may take a week or longer) and should include the following:

- The name of the facility or facilities to which the waste may be sent;
- Its EPA ID number(s) or other unique identifying number(s);
- The city and state in which each potential receiving facility is located;
- The site from which the waste is to be sent;
- The type of waste or wastes to be shipped;
- The amount for each waste to be sent; and
- When the waste is to be shipped.

12 HEALTH AND SAFETY PLAN

The Health and Safety Plan (HASP) for the NBF LTST Removal Action is attached to this Work Plan as Appendix B. This HASP covers initial field investigations, sampling and monitoring, and construction oversight activities and includes example forms specific to Geosyntec. The forms with firm-specific information may be modified by other prime contractors for their use.

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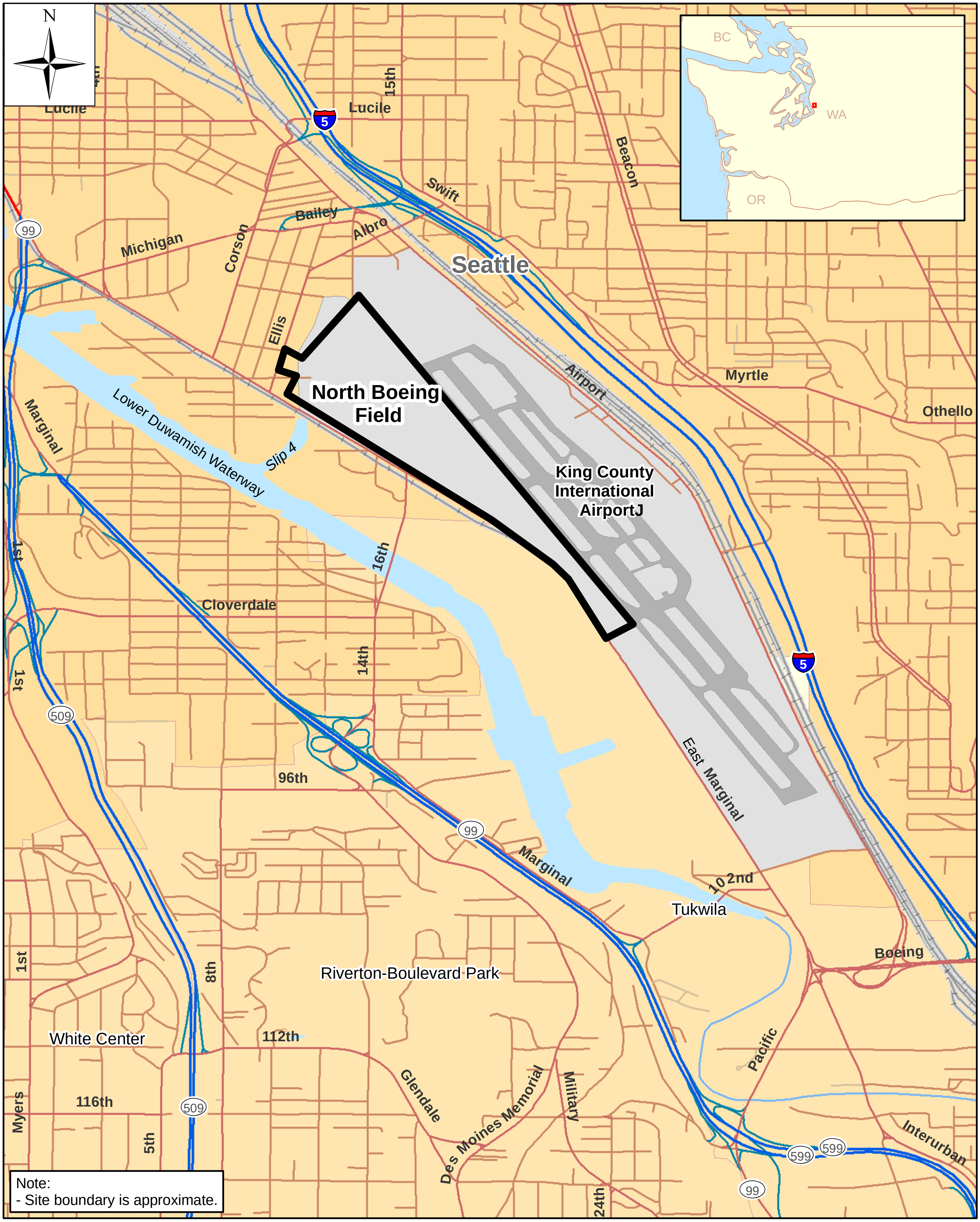
FIGURES



0 0.25 0.5 1 Miles

Geosyntec consultants

Jan 2011

PW0250

Figure 1
Vicinity Map

North Boeing Field
Seattle, Washington

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Notes:
- Buildings and aerial imagery provided by SAIC (2010)

0 375 750 1,500 Feet

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Jan 2011

PW0250

Figure 2
Site Map
North Boeing Field
Seattle, Washington

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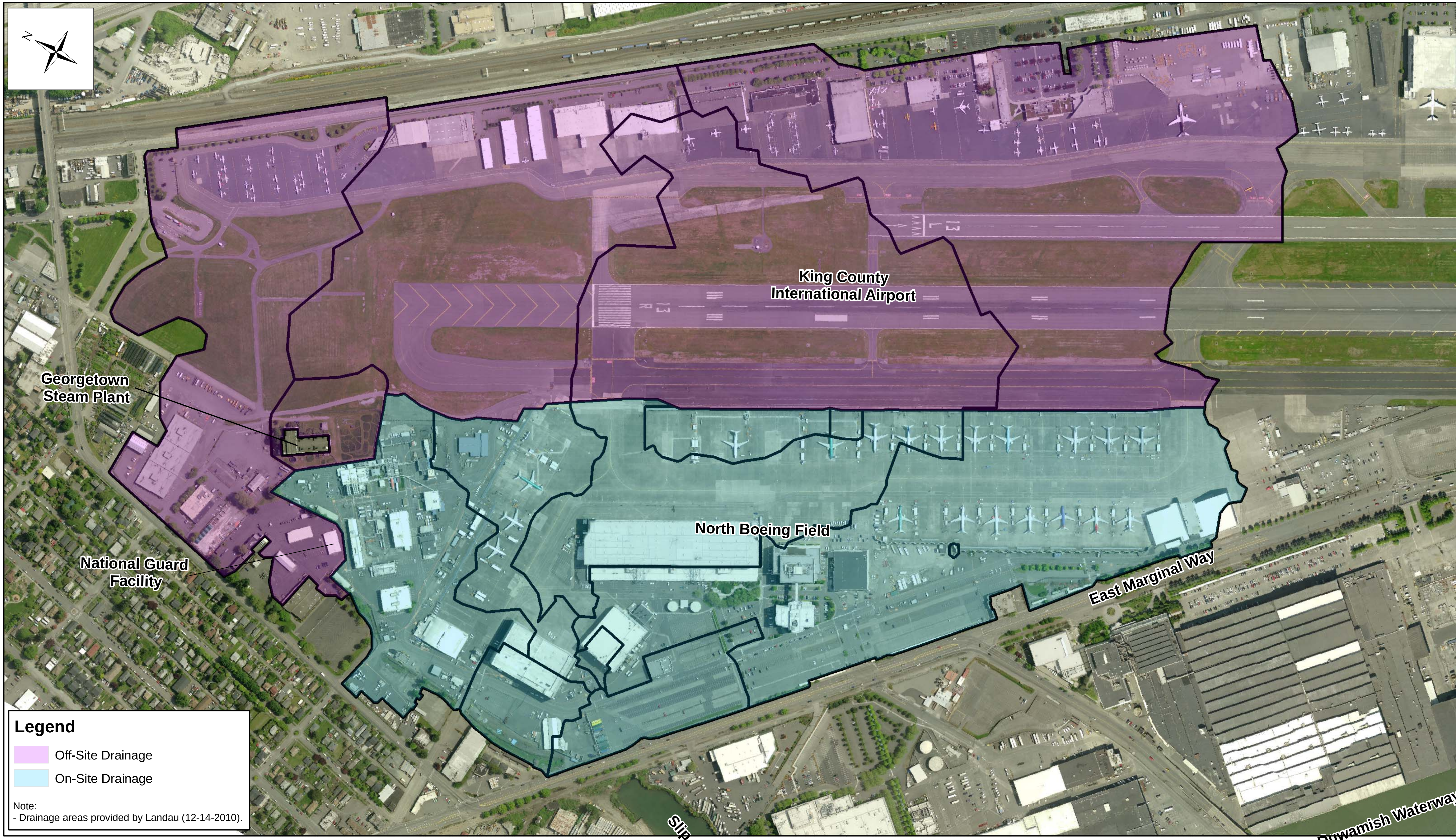

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Figure 3

On-Site and Off-Site Drainage Areas

North Boeing Field
Seattle, Washington

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Figure 4
Storm Drain Structures Map
North Boeing Field
Seattle, Washington

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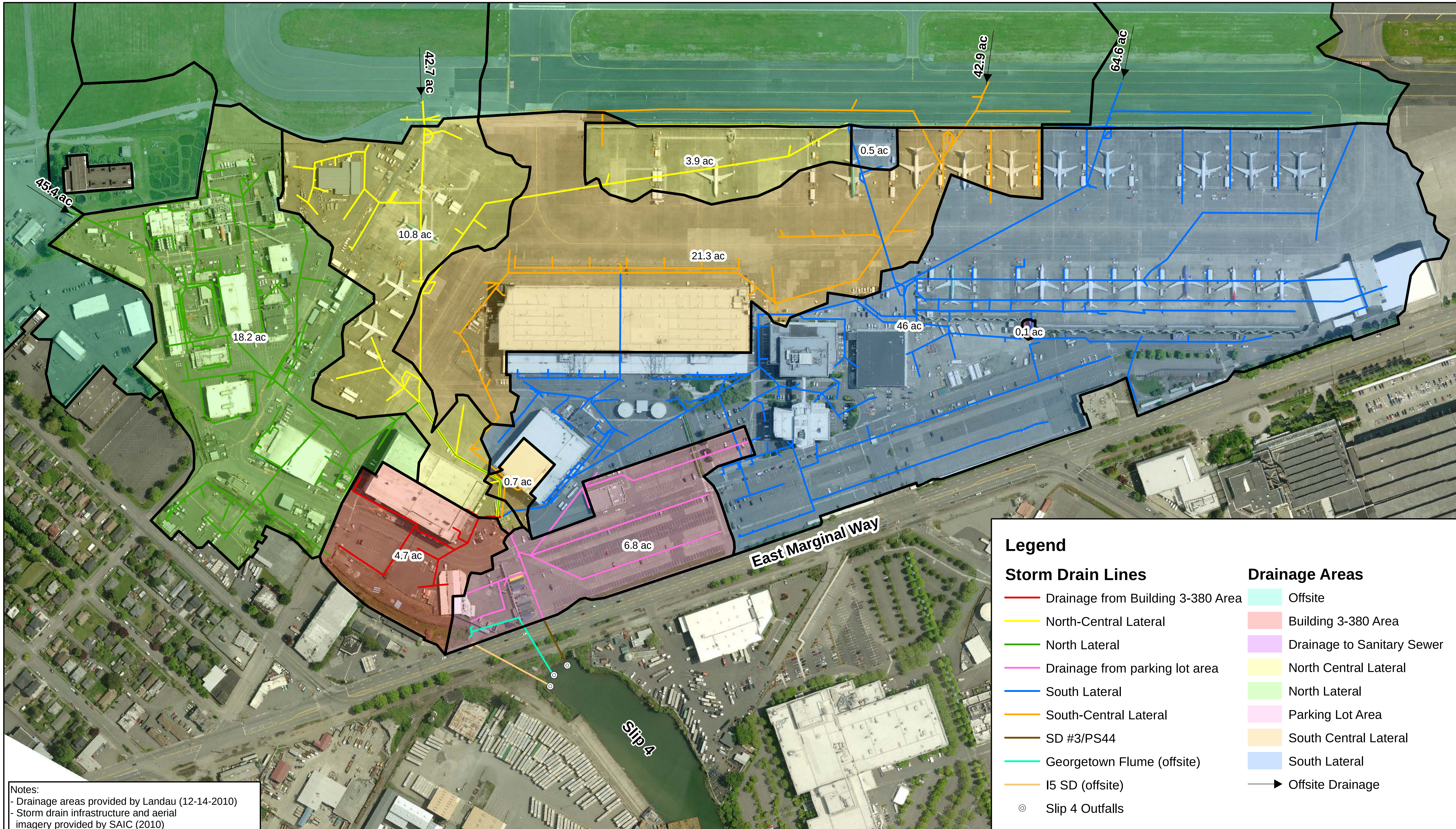

0 250 500 1,000 Feet

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Figure 5

Approximate Storm Drain Lateral Drainage Areas

North Boeing Field
Seattle, Washington

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0	150	300	600 Feet

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Figure 6
Storm Drain Structures Near LS431 and Slip 4
North Boeing Field
Seattle, Washington

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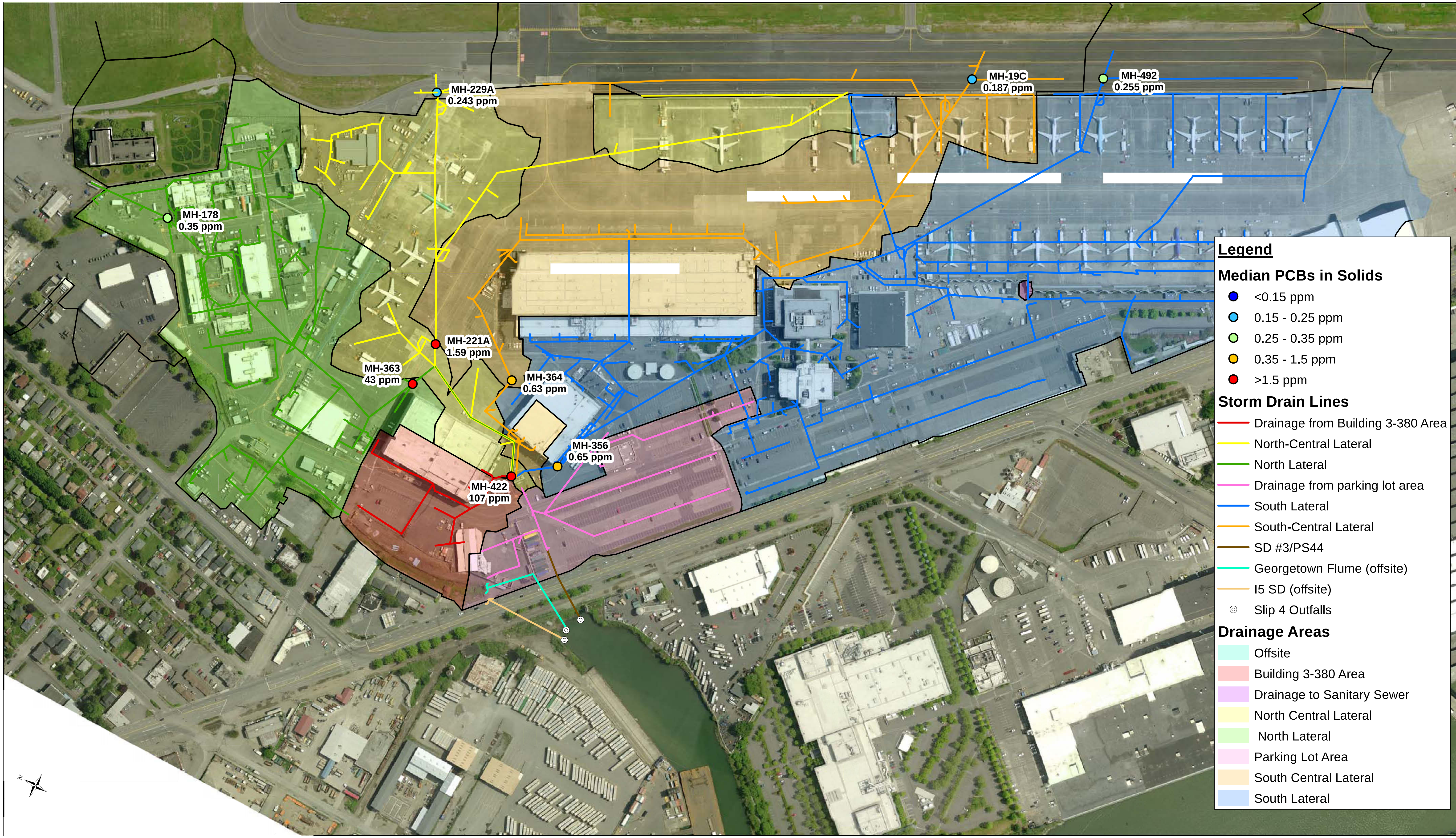

Notes:
1) Site boundary is approximate
2) Drainage areas estimated from Theissen polygons (Landau, 2010a) and were provided by Landau Associates
3) Storm drains, and aerial imagery provided by SAIC
4) Median PCB concentrations computed from data in Landau, 2010a
5) Storm drain structure names and locations from Landau, 2010a

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Figure 7

Sediment Trap PCB Data

North Boeing Field
Seattle, Washington

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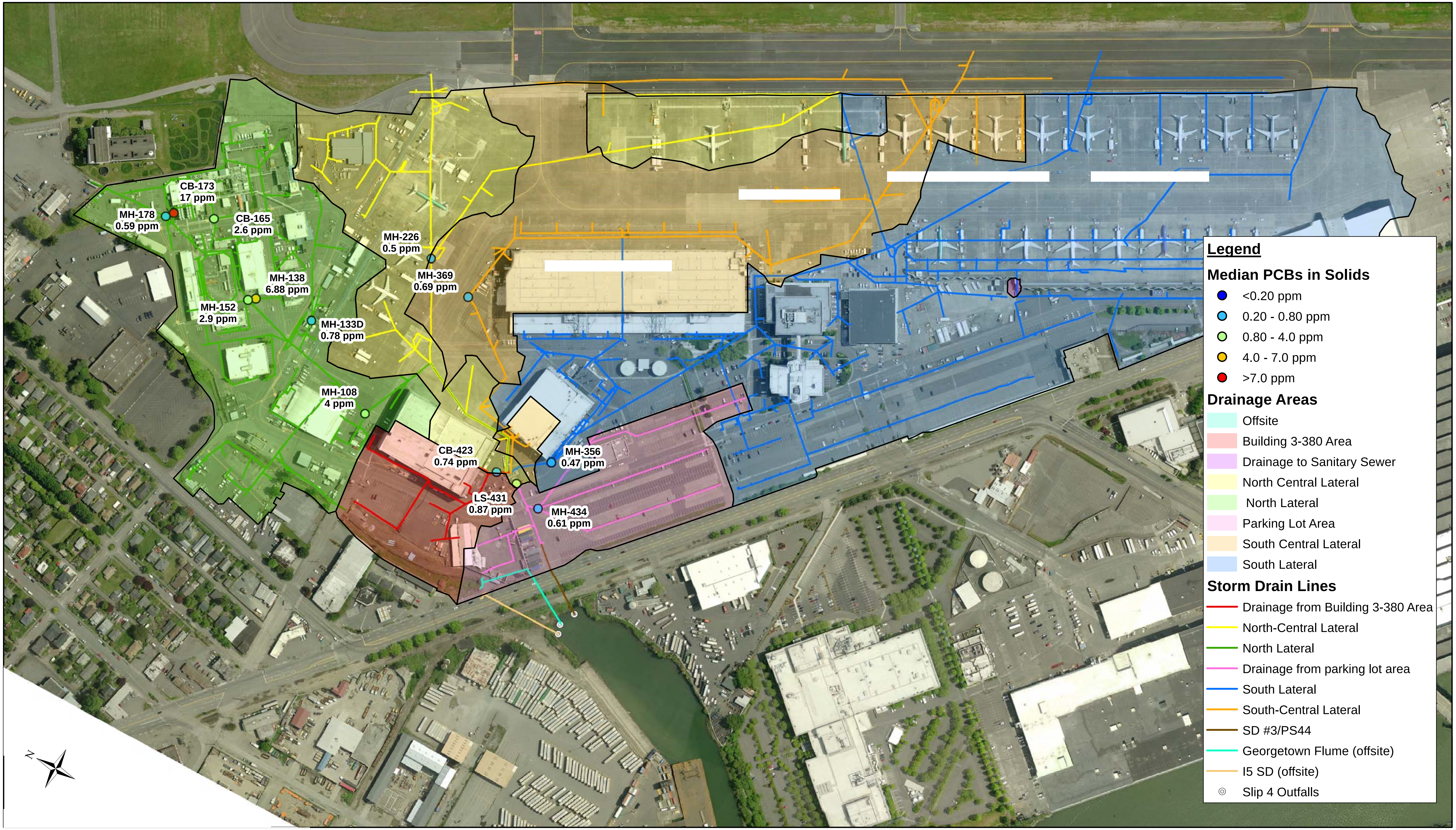

Notes:
1) Site boundary is approximate
2) Drainage areas estimated from Theissen polygons (Landau, 2010a) and were provided by Landau Associates
3) Storm drains, and aerial imagery provided by SAIC
4) Median PCB concentrations computed from data in Landau, 2010a
5) Storm drain structure names and locations from Landau, 2010a

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Figure 8
SAIC Filtered Solids PCB Data
North Boeing Field
Seattle, Washington

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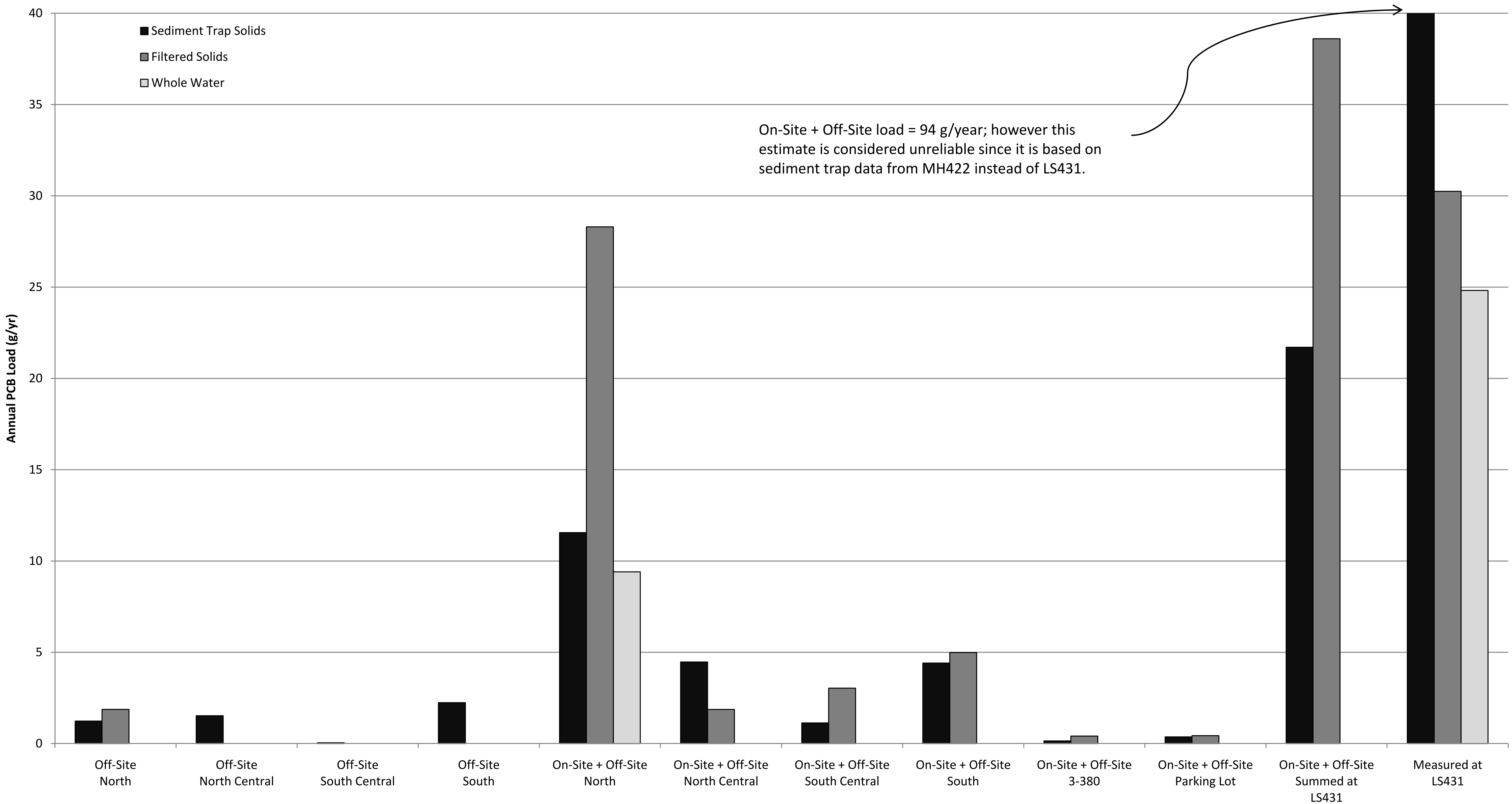
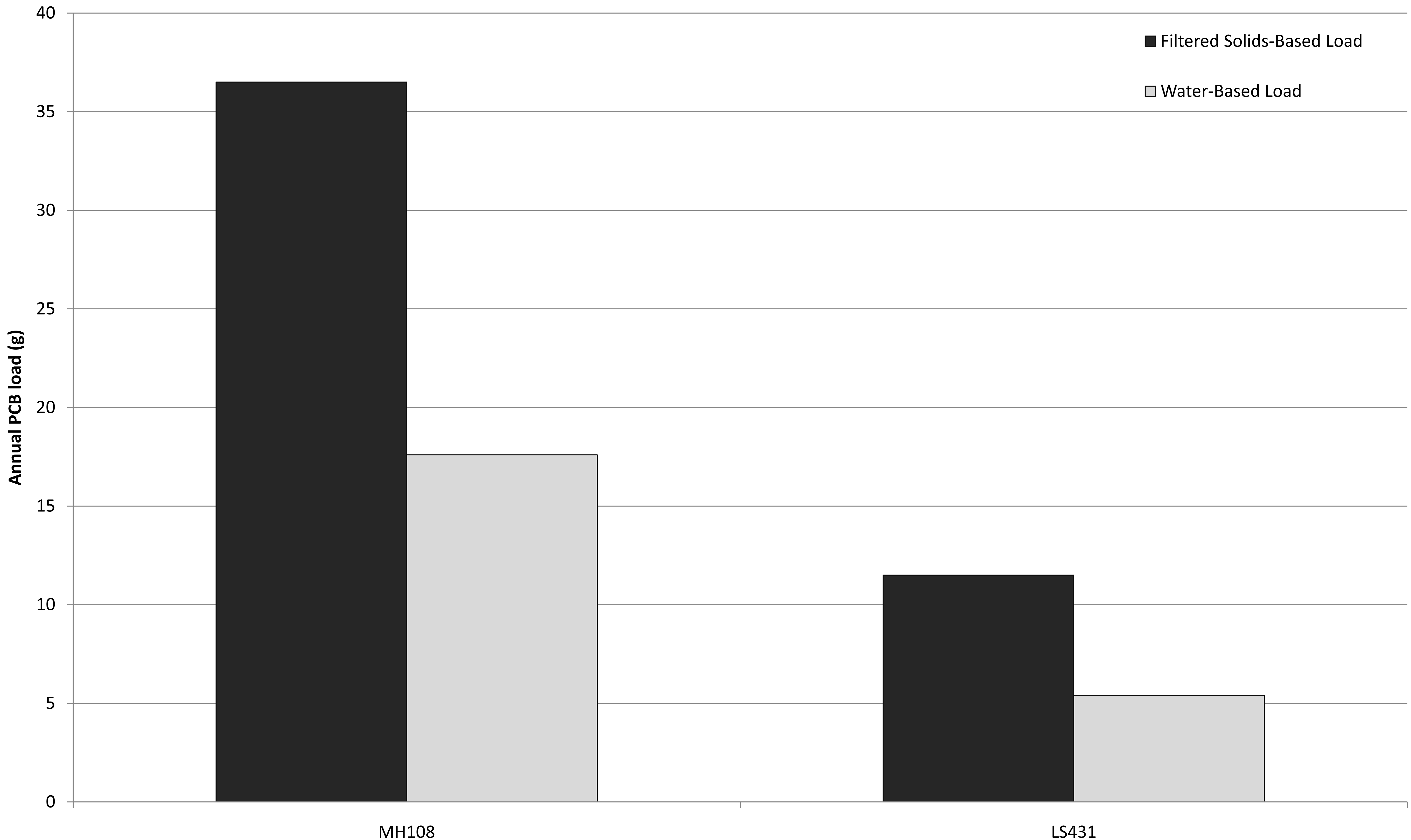


Notes

1) Loads estimated using drainage areas from Landau (2010b) and imperviousness in SAIC, 2010a
2) Sediment trap concentrations are from April 2010 (Landau, 2010a and City of Seattle, 2010).
3) Filtered solids and whole water concentrations are the average 2010 wet weather values (SAIC, 2010a).
4) "Summed at LS431" columns represent the sum of the annual loads at all on site and off site laterals except for Parking Lot, which bypasses LS431.

Geosyntec consultants	Jan 2011	**Figure 9** Annual Average Stormflow PCB Load Estimates North Boeing Field Seattle, WA
	PW0250	



Notes
- Filtered solids and water loads from Table 7 of SAIC Loading Memorandum (2010a)
- It is likely not possible to have a higher load at a downstream location than from all combined laterals at the lift station. This conflict is likely due to data limitations (specifically variability and uncertainty).

Geosyntec consultants	Jan 2011	**Figure 10** Annual Average Baseflow PCB Load Estimates North Boeing Field Seattle, WA
	PW0250	

U.S. Environmental Protection Agency
Karen Keeley, Project Manager – Overall project management for NBF Stormwater ASAOC

Washington State Department of Ecology
Mark Edens, Project Manager – Overall project management for MTCA NBF RI/FS

The Boeing Company
Carl Bach, Environmental Remediation Project Manager – Technical issues
Brian Anderson, Environmental Remediation – EPA coordination
Ray Power, BCA Remediation Focal – NBF stormwater compliance
Jennifer Parsons, Environmental Remediation – Field activity coordination
Fred Wallace, Environmental Remediation – Field activity coordination

Geosyntec Consultants
Eric Strecker, Principal – Principal-in-Charge
Brandon Steets, Senior Engineer - Project management
Megan Patterson, Engineer - Work Plan task management
Marc Leisenring, Project Engineer - AKART and Pre-Design task management
Randy Crawford, Senior Scientist - Salinity Monitoring Plan task management
Dave Parkinson, Senior Scientist – Senior review
Jim Howell, Senior Engineer – Senior review
Lisa Austin, Associate –Senior review

Landau Associates, Inc.
Kris Henderson , Project Manager – Additional stormwater treatment support

Analytical Resources, Inc.
Kelly Bottem, Client Services Manager – Sample analysis

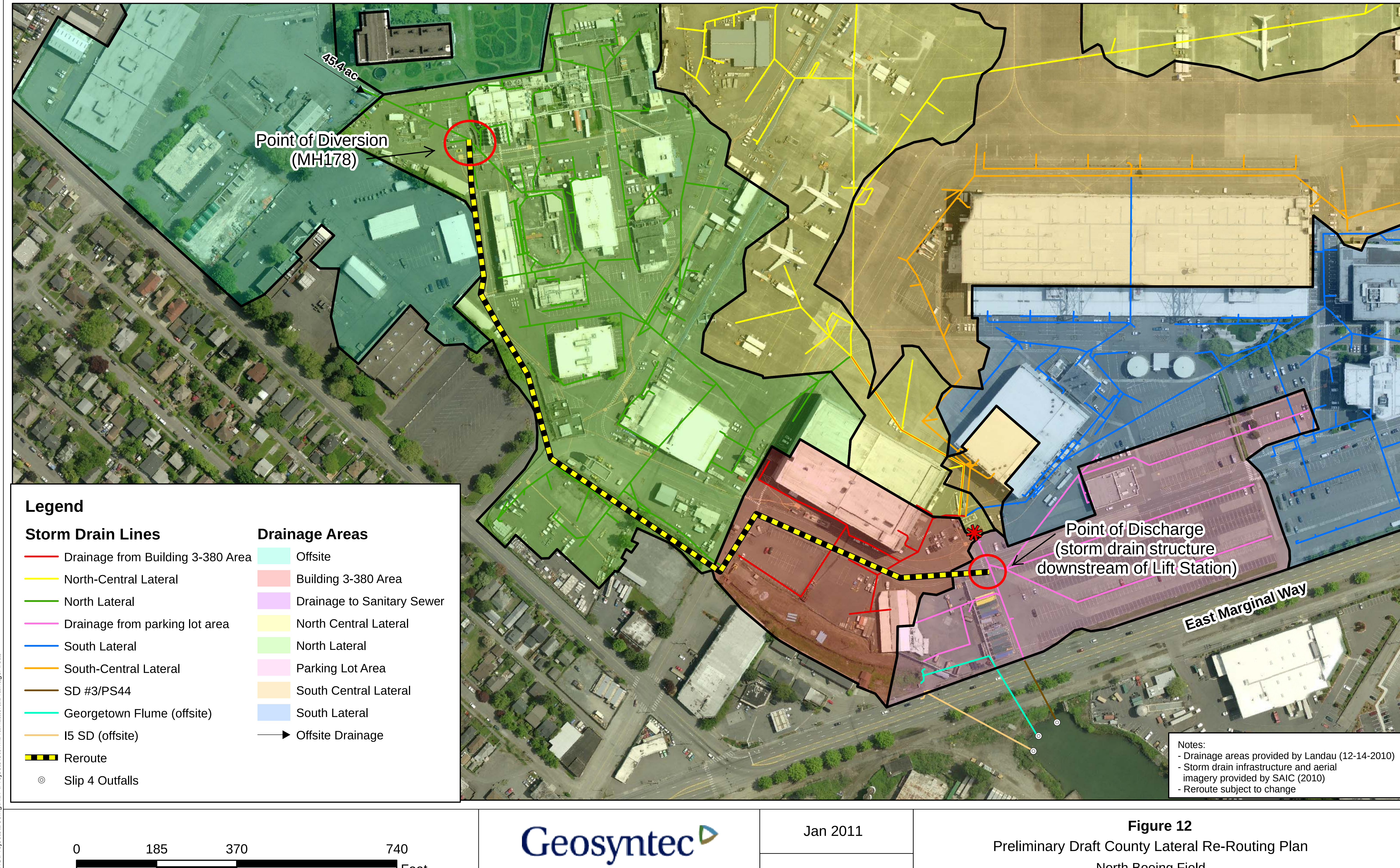
Subcontactor 1
TBD – Surveyor

Subcontactor 2
TBD – Treatment system/pump vendor

Subcontactor 3
TBD – Biology / planting plan

Subcontactor 4
TBD – Construction

Geosyntec consultants	Jan 2011	**Figure 11** Long-Term Removal Action Team North Boeing Field Seattle, WA
	PW0250	



Geosyntec consultants

Jan 2011

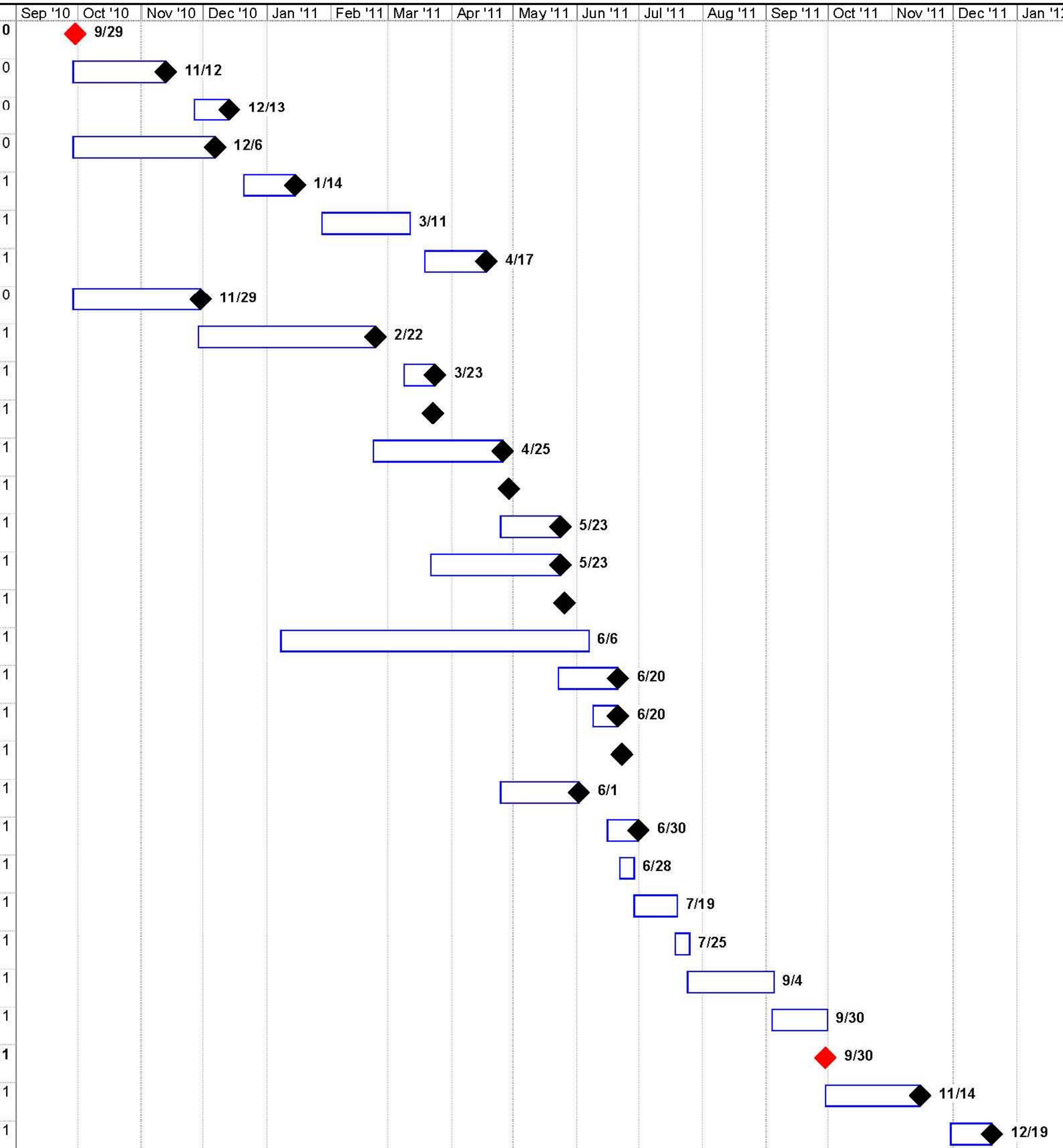
PW0250

Figure 12
Preliminary Draft County Lateral Re-Routing Plan
North Boeing Field
Seattle, Washington

WLA P:\GIS\Projects\Boeing\NBF\Projects\StormDrainLateralDrainageAreas

NBF Long-term Treatment Project Schedule

ID	Task Name	Duration	Start	Finish
1	**Effective Date of ASAOC**	**1 day**	**Wed 9/29/10**	**Wed 9/29/10**
2	Task 2. DRAFT Removal Action Work Plan: Long-term Stormwater Treatment	45 days	Wed 9/29/10	Fri 11/12/10
3	Task 2. FINAL Removal Action Work Plan: Long-term Stormwater Treatment*	17 days	Sat 11/27/10	Mon 12/13/10
4	Draft Slip 4 Salinity Monitoring Plan	69 days	Wed 9/29/10	Mon 12/6/10
5	Final Slip 4 Salinity Monitoring Plan	25 days	Tue 12/21/10	Fri 1/14/11
6	Salinity Monitoring Field Work	43 days	Fri 1/28/11	Fri 3/11/11
7	Salinity Monitoring Data Report	30 days	Sat 3/19/11	Sun 4/17/11
8	Draft AKART Analysis and Engineering Report	62 days	Wed 9/29/10	Mon 11/29/10
9	Task 3A.1. DRAFT Pre-Design Technical Memorandum	86 days	Mon 11/29/10	Tue 2/22/11
10	Task 3A.1. FINAL Pre-Design Technical Memorandum*	15 days	Wed 3/9/11	Wed 3/23/11
11	EPA Design Review Meeting	1 day	Tue 3/22/11	Tue 3/22/11
12	Task 3A.2. Pre-Final (60%) Design	63 days	Tue 2/22/11	Mon 4/25/11
13	EPA Design Review Meeting #2 (tentative)	1 day	Thu 4/28/11	Thu 4/28/11
14	Task 3A.3. 90% Design	29 days	Mon 4/25/11	Mon 5/23/11
15	Task 3B. DRAFT O&M Manual	63 days	Tue 3/22/11	Mon 5/23/11
16	EPA Design Review Meeting #3 (tentative)	1 day	Wed 5/25/11	Wed 5/25/11
17	Treatability Sampling, Media Pilot Testing, and Other Data Gap Sampling	150 days	Sat 1/8/11	Mon 6/6/11
18	Task 3A.4. 100% Design	29 days	Mon 5/23/11	Mon 6/20/11
19	Task 3B. FINAL O&M Manual	12 days	Thu 6/9/11	Mon 6/20/11
20	EPA Design Review Meeting #4 (tentative)	1 day	Wed 6/22/11	Wed 6/22/11
21	Task 3C. DRAFT Monitoring Plan for Water and Solids in Influent and Treated Effluent	38 days	Mon 4/25/11	Wed 6/1/11
22	Task 3C. FINAL Monitoring Plan for Water and Soilds in Influent and Treated Effluent*	15 days	Thu 6/16/11	Thu 6/30/11
23	Prepare and Release Bid Documents	7 days	Wed 6/22/11	Tue 6/28/11
24	Review Bids, Select Contractor, & Negotiate Contract	21 days	Wed 6/29/11	Tue 7/19/11
25	Contractor Mobilization and Material Procurement	7 days	Tue 7/19/11	Mon 7/25/11
26	Construction (incl. material delivery/installation)	42 days	Mon 7/25/11	Sun 9/4/11
27	Startup Testing	27 days	Sun 9/4/11	Fri 9/30/11
28	**Long-term Stormwater Treatment Installed and Operating**	**0 days**	**Fri 9/30/11**	**Fri 9/30/11**
29	DRAFT Removal Action/Stormwater Treatment Completion Report	46 days	Fri 9/30/11	Mon 11/14/11
30	FINAL Removal Action/Stormwater Treatment Completion Report*	20 days	Wed 11/30/11	Mon 12/19/11



Project: PW0250
Date: Fri 1/14/11

Task		Progress		Summary		External Tasks		Deadline	
Split		Milestone		Project Summary		External Milestone			

*Deliverable date dependent on EPA review time.
Assume 2 week EPA review for all deliverables.

Geosyntec consultants

Jan 2011

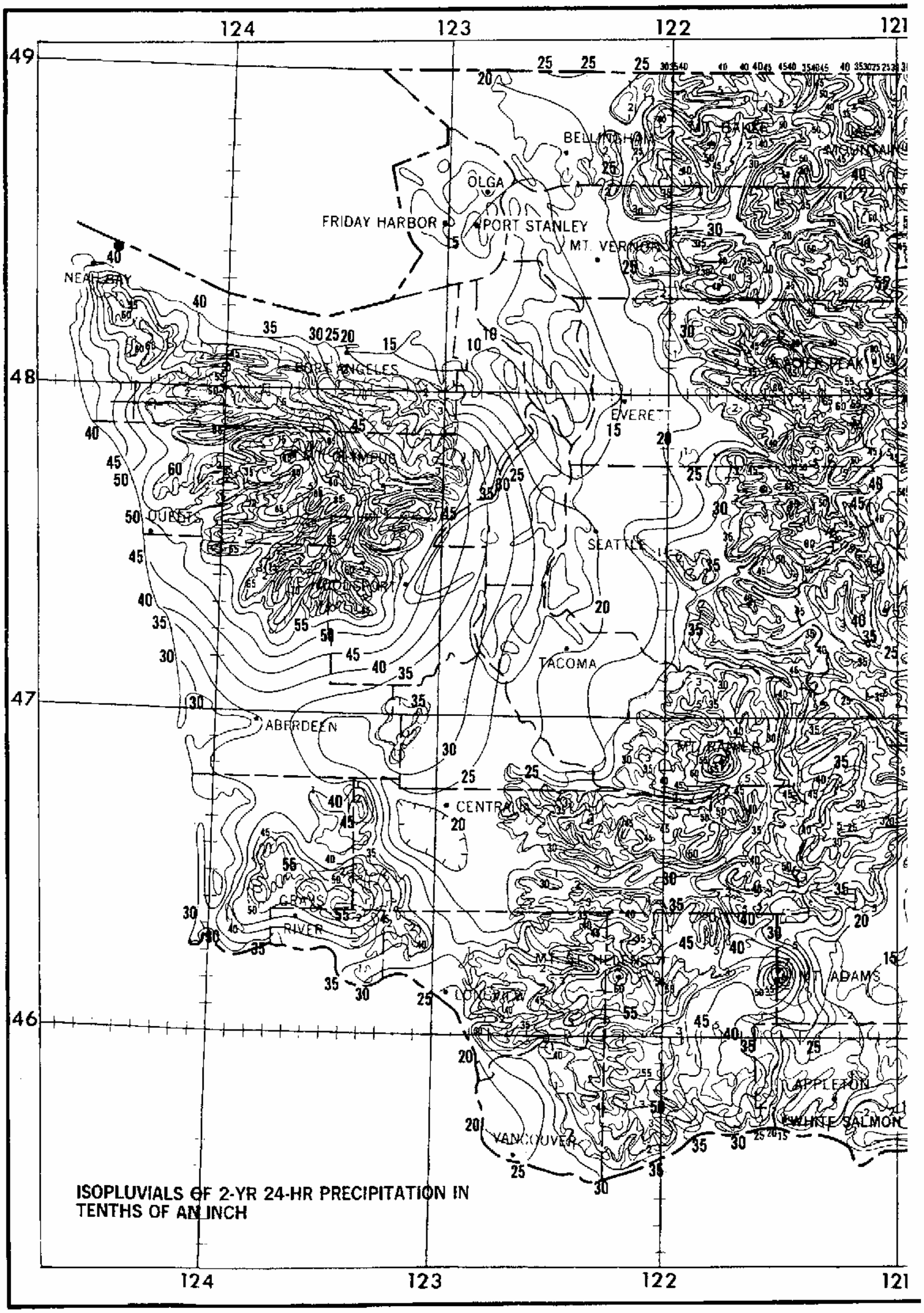
PW0250

Figure 13
LTST Removal Action Schedule
North Boeing Field, Seattle, WA

APPENDIX A

2-Yr, 24-Hr Isopluvial Map

Western Washington Isopluvial 2-year, 24 hour



Geosyntec consultants

APPENDIX B

Health and Safety Plan

The Boeing Company
Slip 4 Early Action Area of the Lower Duwamish Waterway Superfund Site
Seattle, Washington

APPENDIX B:

HEALTH AND SAFETY PLAN

LONG-TERM STORMWATER TREATMENT WORK PLAN NORTH BOEING FIELD

Prepared by

Geosyntec consultants

engineers | scientists | innovators

6701 Center Drive West, Suite 550
Los Angeles, CA 90045

Project Number: PW0250

January 2011

Instructions for Injury Response

IF LIFE THREATENING: CALL 911

If not life threatening but requiring emergency care:

Seek immediate medical attention at the hospital/facility that provides emergency care shown on **FIGURE 1A**.

- **Once the emergency situation has stabilized, follow the "Instructions for Incident Reporting" included in this HASP.**

If Not Requiring Emergency Care:

Manager/Supervisor calls the EHS Department at **(804) 349-8067 (Dale Prokopchak)** or **(404) 435-4722 (Ersin Yalcin)** to discuss appropriate medical attention (even if he/she thinks medical attention is not required). If professional care is needed, seek medical attention at the URGENT CARE facility shown on **FIGURE 1B**.

- **Present the medical care provider with the TEAR-OUT FORMS (*"Instructions to Medical Provider"* and *"Physical Status for Return to Work"*) included in this HASP.**
- **Follow the *"Instructions for Incident Reporting"* included in this HASP within one hour.**

FIGURE 1A
ROUTE TO HOSPITAL

- Distance to hospital: 5.5 miles
- Approximate travel time to hospital: 10 minutes

HOSPITAL NAME
Harborview Medical Center (206) 744-3754
325 9th Ave
Seattle, WA 98104

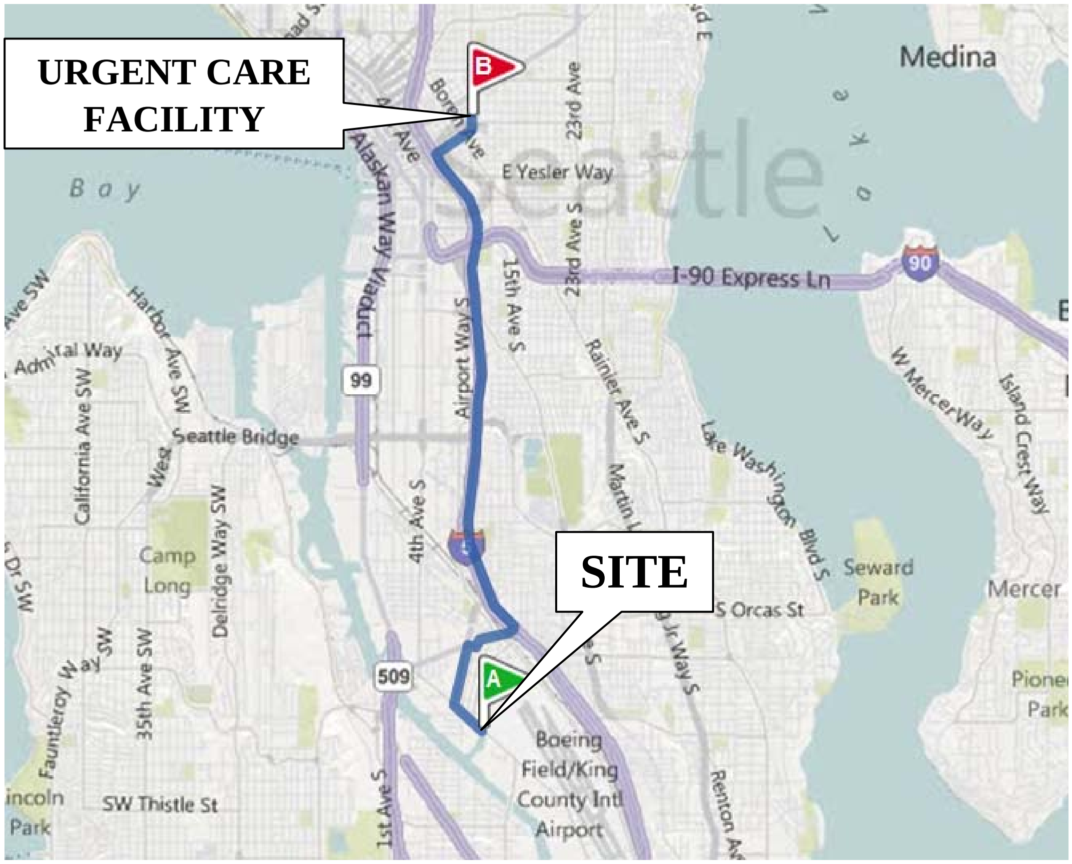
Written Directions to Hospital from Site:

Depart E Marginal Way S toward Ellis Ave S	0.3 mi
Turn right onto Corson Ave S	0.5 mi
Turn right onto S Bailey St SHELL on the corner	0.1 mi
Take ramp left for I-5 North toward Vancouver BC	3.1 mi
At exit 164A, take ramp right for James St toward Madison St	1.3 mi
Turn right onto James St	0.1 mi
Turn right onto 9th Ave	0.1 mi

Arrive at 325 9th Ave, Seattle, WA 98104-2420 on the right.
The last intersection is Jefferson St. If you reach Alder St, you've gone too far.

FIGURE 1B
ROUTE TO URGENT CARE FACILITY

- Distance to hospital: 6.7 miles
- Approximate travel time to hospital: 10 minutes



URGENT CARE FACILITY NAME

Swedish Health Services (206) 320-3100
747 Broadway
Seattle, WA 98122

Written Directions to Urgent Care Facility from Site:

Start out going NORTHWEST on E MARGINAL WAY S toward ELLIS AVE S.	0.31 mi
Turn RIGHT onto CORSON AVE S.	0.50 mi
Turn RIGHT onto S BAILEY ST.	317 ft
Merge onto I-5 N via the ramp on the LEFT toward VANCOUVER BC.	3.13 mi
Take the DEARBORN ST/JAMES ST exit, EXIT 164A, toward MADISON ST.	1.03 mi
Take the JAMES ST exit.	0.26 mi
Turn RIGHT onto JAMES ST.	0.34 mi
Turn LEFT onto BROADWAY.	317 ft

FIGURE 2
SITE MAP

EMERGENCY RESPONSE PROCEDURES

- The Site Health and Safety Officer (SHSO), or designated alternate, should be immediately notified via the on-site communication system. The SHSO assumes control of the emergency response for the work area.

- If applicable, the SHSO must immediately notify off-site emergency responders (i.e., fire department, hospital, police department, etc.) and must inform the Boeing security and response team of the nature and location of the emergency on site.

- If applicable, the SHSO calls for evacuation of the work area. Site workers should move to their respective refuge stations using designated evacuation routes (to be determined).

- For small fires, flames should be extinguished using the fire extinguisher. Large fires should be handled by the local fire department.

- If a worker is injured, the procedures presented in "Instructions for Injury Response", located in the front of this HASP, must be implemented immediately.

- After an incident has stabilized, the procedures presented in "Instructions for Incident Reporting", located in the front of this HASP, must be followed.

EMERGENCY RESPONSE CONTACT INFORMATION

Contact	*Telephone Numbers*		*Date of Pre-Emergency Notification (if required)*
	Office	*Alternate (Type)*	
Fire Department	(206) 243-0330	911	
Police Department	(206) 386-1850	911	
Hospital - Harborview Medical Center	(206) 744-3754	911	
Site-Specific Emergency Response (if applicable)	To Be Determined		
Director of Environment, Health & Safety – *Dale Prokopchak*	(804) 332-6376	(804) 349-8067 (Cell)	
EHS Manager – *Ersin Yalcin*	(678) 202-9552	(404) 435-4722 (Cell)	
Project Manager – *Brandon Steets*	(805) 979-9122	(805) 455-9591 (Cell)	
Site Health & Safety Officer (SHSO) – *Dave Parkinson*	(206) 826-7184	(206) 618-0350 (Cell)	
Environmental, Health & Safety Coordinator – *Marc Leisenring*	(503) 222-9518		
Principal- or Associate-in-Charge – *Eric Strecker*	(503) 222-9518	(503) 805-0479 (Cell)	
Office Manager – *Eric Strecker*	(503) 222-9518	(503) 805-0479 (Cell)	
Utility Emergencies	811		
EPA (if applicable)			
State Regulatory Agency (if applicable)			
Other -			

Dear Medical Provider:

On behalf of Geosyntec Consultants/MMI Engineering, you are authorized to evaluate and treat the above Geosyntec/MMI employee today for an alleged work-related injury or illness.

Employee Name: ________________________________
Alleged Injury: ________________________________
Date of Alleged Injury: ____________________________
Date of Medical Evaluation: _________________________

Geosyntec/MMI strives to reduce OSHA recordables; therefore, ***please do not prescribe or dispense prescription medications if OTC medications or non-prescription strength can be used*****.** It is our primary interest to ensure this employee returns to work full duty. If a full duty release is not possible, Geosyntec/MMI may be able to find light duty for the **employee**; ***unless it is unavoidable, please do not prescribe lost time.*** We would appreciate it if you would complete the attached form "Physical Status for Return to Work", or a similar form, to assist us in evaluating this employee's work capabilities.

- Please fax a copy of all medical paperwork and "Physical Status for Return to Work Form" to Dale Prokopchak at (804) 332-6732.
- Invoices and supporting medical records should be mailed to:

  Gail Hapeman
  Human Resources Department
  Geosyntec Consultants
  5901 Broken Sound Parkway, NW, Suite 300
  Boca Raton, FL 33487
  Phone: 561.922.1002
  Fax: 561.922.1101

Thank you for your assistance.

Very truly yours,

Dale Prokopchak, CIH, CSP
Director of Environmental Health and Safety

Geosyntec consultants

PHYSICAL STATUS FOR RETURN TO WORK
PLEASE FAX COMPLETED FORM TO DALE PROKOPCHAK AT (804) 332-6732

Employee Name ___________________________ Date of Injury/Illness _______________

TO BE COMPLETED BY TREATING PHYSICIAN

Diagnosis ____
I saw and treated this patient on (date) ______________ and:

__ Release the patient to full duty with no limitations on (date) _______________
__ Patient may return to work with the following limitation on (date) _______________ and may work an 8 hr. shift unless specified otherwise.

LIFTING CAPACITY

__ Occasional lifting (10 lbs. max.) and lifting and carrying occasionally. Walking and standing occasionally.
__ Occasional lifting (20 lbs. max.). Significant walking, standing; or sitting with pushing and pulling with arms or legs.
__ Occasional lifting (50 lbs. max.) with frequent lifting and/or carrying up to 25 pounds.

OTHER ACTIVITIES

		SINGLE DURATION					IN AN 8 HOUR DAY PATIENT MAY DO				
LIMITATION	NO LIMITATION	< 1/2 hr	1/2-1 hr	1-2 hr	2-4 hr	4-6 hr	1/2-1 hr	1-2 hr	2-4 hr	4-6 hr	6-8 hr
SIT											
STAND											
WALK											
USE RIGHT HAND											
USE LEFT HAND											

	NO LIMITATION	FREQUENTLY (31%-60%)	OCCASIONALLY (1%.-30%)	NEVER
BEND				
SQUAT				
CLIMB				
REACH OVERHEAD		WEIGHT LIMIT	WEIGHT LIMIT	
REACH SHOULDER		WEIGHT LIMIT	WEIGHT LIMIT	
PUSHING/PULLING		WEIGHT LIMIT	WEIGHT LIMIT	

Other instructions or limitations:
____
____

Estimated length of time of modified duty: ____

__ These restrictions are in effect until (date) ______________ or until patient is reevaluated on (date) _______________
__ Patient is totally incapacitated at this time. Patient will be reevaluated on (date) ________________

Physician Signature ____ Date ________________

ADDITIONAL NOTES:



Instructions for Incident Reporting

Once an emergency situation has been stabilized, or within one hour of a non-emergency incident:

Manager/Supervisor calls the EHS Department at **(804) 349-8067** or **(404) 435-4722**—to discuss appropriate medical attention. If unable to contact the EHS Department within one (1) hour, a detailed voicemail with information about the incident must be provided and Gail Hapeman in HR [(561) 922-1101] should be contacted to get the name and address of closest Workers' Comp provider.

- Manager/Supervisor contacts Gail Hapeman in Human Resources, Office: (561) 922-1002, Mobile: (561) 789-6830, with additional details of the incident.
- Within 24 hours, the Manager/Supervisor completes a draft of the "Manager's Report of Incident", located in this HASP and on the EHS website, and sends to Gail Hapeman at (561) 922-1101.
- Manager/Supervisor forwards the finalized paperwork within 48 hours to both EHS (dprokopchak@geosyntec.com); fax (804) 332-6732 and HR (ghapeman@geosyntec.com); fax (561) 922-1101 for review, documentation, and implementation into our case management program.
- Contractors are responsible for compliance with their internal safety procedures regarding Incident Reporting. Geosyntec will document the Contractor's incident in their Project Logbook.
- In the event of a vehicle accident that does not involve injuries, please follow the procedures outlined in EHS 105—Driver Safety.

Contact Information

Dale Prokopchak: office: 804.332.6376 | cell: 804.349.8067 | fax: 804.332.6732 | dprokopchak@geosyntec.com
Ersin Yalcin: office: 678.202.9552 | cell: 404.435.4722 | fax: 678.202.9501 | eyalcin@geosyntec.com
Gail Hapeman: office: 561.922.1002 | fax: 561.922.1101 | ghapeman@geosyntec.com

DRIVER'S REPORT OF ACCIDENT – PAGE 1

Select & Zoom

Driver's Report of Accident

Do not argue at the scene of the accident. Be courteous and show your license willingly.

Your Vehicle

Name of Driver ______________________

Odometer Reading ______________________

Vehicle I.D. No. ______________________

License Plate No. ______________ State ______

Place of Accident ______________________

____

City/State ______________________

Direction of Travel ______________________

Speed ______________________

Other Vehicle

Name of Driver ______________________

Address ______________________

____

Phone No. ______________________

Driver's License No. ______________________

License Plate No. ______________ State ______

Vehicle I.D. Number ______________________

Year/Model ______________________

Owner of Vehicle ______________________

Address of Owner ______________________

____

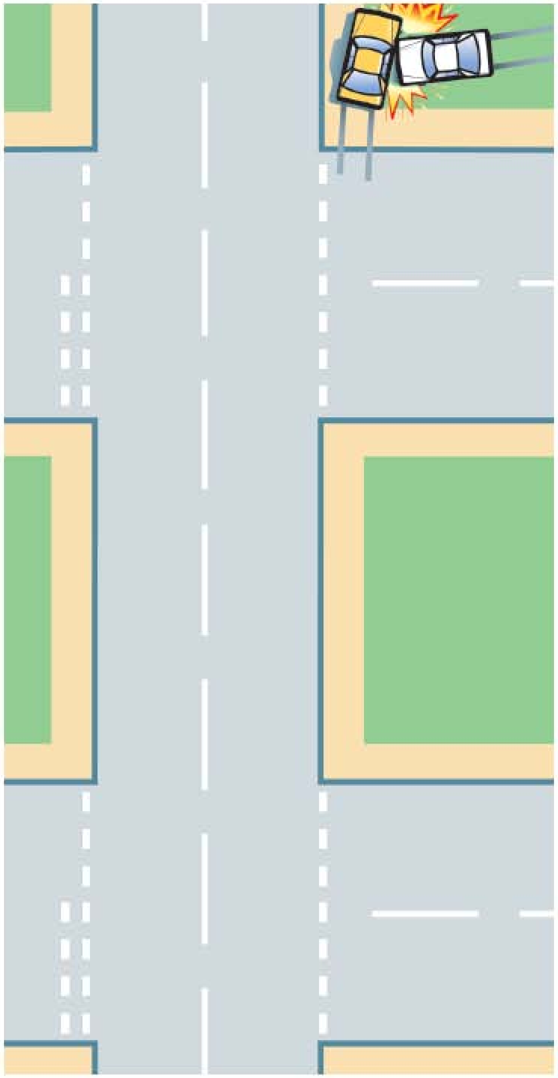
Insured by ______________________

Direction of Travel ______________________

Approximate Speed ______________________

Diagram of Accident

Using the diagram below, show exact relationship of roadways and vehicles at the time of the accident. (Indicate North) Show measurements if possible (identify your vehicle as #1, other vehicles as #2, #3, etc.)



What to do in Case of a **Vehicle Accident**

Geosyntec consultants

DRIVER'S REPORT OF ACCIDENT – PAGE 2

Here is What to do

1. Take precautions necessary to protect the scene of the accident from further accidents.
2. Call police immediately, if someone is injured, request medical assistance. In case of fire, request fire department.
3. If there are any injuries, follow the requirements of the injury, illness, near miss procedure
4. Be courteous. Answer police questions. Give identifying information to the other party involved, but make no comments about assuming responsibility
5. Complete this ACCIDENT REPORT FORM. You will need this information later for state and insurance reports.
6. Report the accident to your immediate supervisor and office manager as quickly as possible. The Office Manager will send the completed form to Natasha Pinkerton of Human Resources: phone (561) 922-1003; fax (561) 922-1101. Human Resources will contact our insurance carrier Marsh: fax (954) 838-3700. If the vehicle accident results in a Geosyntec employee being injured and requiring medical attention, Human Resources will notify both appropriate personnel within their Department and the EHS Department.
7. Take photographs of the damage if it is safe to do so.
8. Do not leave the scene of the accident, until police have arrived or you're being transported by rescue.

Description of Accident

Date ______ Time ______ ○ am ○ pm

Road Condition ______

Time of Day (check one) ○ Daylight ○ Dawn/Dusk ○ Night

Weather Condition (check one) ○ Foggy ○ Cloudy ○ Clear

Road Surface (check one) ○ Wet ○ Damp ○ Dry

Description ______

______

Driver's Signature ______

Employer Geosyntec Consultants

Branch Location ______

Branch Phone Number ______

Witnesses

1. Name ______
   Address ______
   ______
   Phone ______
2. Name ______
   Address ______
   ______
   Phone ______

Police Investigation

Name of Officer ______

Report Number ______

Name of Police Agency ______

Was Summons Issued ○ Yes ○ No

Injured Persons

1. Name ______ DOB: ______
   Address ______
   ______
   Nature of Injury ______
2. Name ______ DOB: ______
   Address ______
   ______
   Nature of Injury ______

Damage to Property

1. Owner ______
   Address ______
   ______
   Damaged Property ______
   ______
   Extent of Damage ______
   ______
   ______
2. Owner ______
   Address ______
   ______
   Damaged Property ______
   ______
   Extent of Damage ______
   ______
   ______

MANAGER'S REPORT OF INCIDENT

1. Seek immediate medical attention if the injury/illness is serious and/or life threatening.
2. Employee must report all incidents and near misses to their supervisor **immediately**
3. Supervisor must immediately notify the EHS Department at **(804) 349-8067 or (404) 435-4722** with details of the incident, and discuss appropriate medical care for non life threatening injury/illness.

EMPLOYEE INFORMATION

Name: ____________________________ Position: ____

Department #: ______________________ Employee #: __________________ Phone #:_______________________

Supervisor Name: ___________________

FACTS OF INCIDENT

☐Injury ☐Illness ☐General Liability ☐ Near Miss Date and Time of Incident: _________________

Date and Time Accident Reported: _____________________ To Whom: _________________________________

Where did the incident occur (location name and street address)? ____

City: ____________________ State/Province_________________ Zip/Postal Code: _____________________

County ______________________ Country: ___________________________________

What was the employee doing when the incident occurred? Name the tools, equipment or material the employee was handling and what he was doing with them. ____

____

____

Explain how the incident occurred. List events leading up to incident, what happened, how it happened and name objects and how they were involved (use a separate sheet if necessary). ____

____

____

NATURE OF INCIDENT

Describe incident and indicate body part affected if injury (e.g. cut on middle left finger). ___________________________________

____

____

Name object or substance that injured the employee.____

____

Has any prior, related injury to affected area of body occurred while employed at Geosyntec/MMI? ☐ Yes ☐No

MEDICAL ATTENTION GIVEN (check all that apply)

☐First Aid given by ____________________ Date/Time __________________________ Phone _______________________

☐Doctor's Name ______________________ Date/Time __________________________ Phone ________________________

Address ____

☐Hospital Name ______________________ Date/Time __________________________ Phone ________________________

Address ____

☐Released ☐Admitted Length of Stay: __________________________

Did the employee go to an Emergency Room? ☐ Yes ☐ No

EMPLOYEE'S DESCRIPTION OF THE INCIDENT (IN OWN WORDS)

Describe incident and indicate body part affected (e.g. cut on middle left finger) and what you were doing when the incident occurred (be specific) ______________________________

____

____

____

Explain how the incident occurred. List events leading up to incident, what happened, how it happened and name objects and how they were involved (use a separate sheet if necessary). ______________________________

____

____

____

Employee's Signature ______________________ Date______________________

ADDITIONAL INFORMATION (TO BE COMPLETED BY THE MANAGER)

Witnesses

Name: ______________________ Phone: ______________________

Name: ______________________ Phone: ______________________

What do you believe could be done to help prevent incidents of this type (be specific)? ______________________

____

____

____

Any additional Comments ______________________________

____

____

____

Manager's Signature ______________________ Date______________ Phone #: ______________

HR/EHS

OSHA Recordable?: ☐ Yes ☐ No ☐ Pending WC? ☐ Yes ☐ No

Days away from work: __________ Days of restricted work activity: __________ Date returned to work ______________

HR Manager's Signature ______________________ Date______________________

Comments: ______________________________

EHS Manager's Signature ______________________ Date______________________

Comments: ______________________________

Manager must complete this form within 24 Hours of the incident and fax a copy of this report to Human Resources at (561) 922-1011 and EHS at (804) 332-6732

TABLE OF CONTENTS

<u>Items Located Before the Table of Contents</u>

Instructions for Injury Response

Figure 1A:	Route to Hospital (inside cover)
Figure 1B:	Route to an Urgent Care Facility (inside cover)
Figure 2:	Site Map (inside cover)

Emergency Response Procedures
Emergency Response Contact Information
Instructions to Medical Provider (Tear-Out Form)
Physical Status for Return to Work (Tear-Out Form)
Instructions for Incident Reporting
Driver's Report of Accident (Tear-Out Form)
Manager's Report of Incident Form (Tear-Out Form)

<u>Items Located After the Table of Contents</u>

Table 1:	Key Personnel and Health & Safety Responsibilities
Table 2:	General Safe Work Practices

Appendix A:	HASP Amendments
Appendix B:	Health & Safety Inspection Checklist
Appendix C:	Hazard Analysis and Hazard Mitigators
Appendix D:	Constituents of Concern (COCs) and COC Fact Sheets
Appendix E:	Air Monitoring Equipment, Frequency of Readings, and Action Guidelines per Task
Appendix F:	Personal Protective Equipment per Task

1. SIGNATURES

1.1 Preparers and Reviewers

This HASP, which must be maintained on site when field work is being performed, addresses the health and safety hazards of each phase of site operation, including the procedures and equipment required for worker protection. Only the Site Health and Safety Officer (SHSO) can change or amend this document, in agreement with the Environmental Health and Safety Coordinator (EHSC), and Project Manager. The SHSO must initial any change made to the HASP at the relevant section. Major amendments (e.g., changes in personal protective equipment, addition of tasks, etc.) must be documented in Section 3 and in Appendix A. This HASP must be reviewed and amended on an annual basis for projects lasting more than one year.

Prepared by:	David Hack SHSO	1/14/11 Date
Reviewed by:	Marc Leveray EHSC	1/12/2011 Date
Approved by:	Brandon Stout Project Manager	1/12/2011 Date
Approved by: (as needed)	Principal- or Associate-in-Charge	Date

Copy Cover Sheet to: EHSC

This HASP has been given to the following subcontractor(s) in accordance with the Occupational Safety and Health Administration (OSHA) HAZWOPER Standard, per Chapter 29 of Code of Federal Regulations (CFR), Subsection 1910.120.

Subcontractor: _______________ Representative: _______________ Date: ________

Subcontractor: _______________ Representative: _______________ Date: ________

Subcontractor: _______________ Representative: _______________ Date: ________

1.2 Site Workers

A pre-entry briefing conducted by the SHSO must be held prior to initiating the field work of this project. All sections of this HASP must be reviewed during this briefing. Any worker not in attendance at the initial meeting must be trained by the SHSO on the information covered in the pre-entry briefing. Tailgate meetings must be held at the beginning of each day by the SHSO to discuss important health and safety issues concerning tasks to be performed during that shift. Topics discussed in the tailgate meetings must be documented in a daily field log. Weekly site health and safety audits must be performed and documented by the SHSO for projects lasting more than one week. After reading the HASP and attending a pre-entry briefing, Geosyntec employees must sign the following acknowledgment statement.

"I have read, understand, and agree with the information set forth in this HASP. I have also attended a pre-entry briefing. I agree to perform my work in accordance with this HASP."

Signature	Printed Name	Date

2. DISCLAIMER

This HASP was prepared in accordance with Geosyntec Consultants' Health and Safety Procedures for use by Geosyntec project staff. This plan complies with Geosyntec internal review procedures. Geosyntec does not endorse the use of this HASP by others. This document and its contents should not be used by firms other than Geosyntec or by persons other than Geosyntec employees without a thorough peer review by their health and safety managers. Should the work outlined in this HASP be executed by contractors other than Geosyntec, the HASP should be modified and reviewed to comply with such company's corporate health and safety procedures. In the event that a contractor other than Geosyntec executes this work, the contractor should complete independent analyses of hazards and mitigation measures, and should update all HASP tables, text, figures, and appendices prior to commencing work. Geosyntec assumes no responsibility for the accuracy, content, or health and safety of non-Geosyntec personnel during the implementation of the work in this HASP by other parties.

3. HASP AMENDMENTS

Over the course of this project, it is possible that the project-specific details and working conditions will change. This HASP shall be reviewed and amended as necessary to effectively describe the changing working conditions and to mitigate the potential health and safety issues that may arise during the project. Amendments to the HASP should be briefly described in the following spaces provided. The full text of the amendments should be provided in Appendix A.

AMENDMENT 1:

Date: __________ Project Manager: ____________ EHSC: ___________________
Brief description of amendment:

____

____

AMENDMENT 2:

Date: __________ Project Manager: ____________ EHSC: ___________________
Brief description of amendment:

____

____

4. SITE/TASK DESCRIPTION

The following is a brief description of the site, including information as to the location, approximate size, previous usage, and current usage. A description of the tasks to be performed is also presented.

- Site Location: North Boeing Field
- Approximate Size of Site: 180 acres
- Previous Site Usage: Airplane production
- Current Site Usage: Airplane production
- Description of Surrounding Property/Population:

North	Commercial and residential	East	King County International Airport
South	Industrial and commercial	West	East Marginal Way. Industrial land uses adjacent to Slip 4 and the Lower Duwamish Waterway

- Summary of previous site investigations (if available/applicable):

- Task Descriptions:

Task 1: Site Investigation

An initial site investigation will take place to collect visual data of the site and gather information to appropriately plan for future site work. Potential hazards may include fire, heavy equipment, cold stress, heat stress, hand/foot injury, loud noise, slips, trips, falls, stinging insects, flash floods, and thoroughfares.

Task 2: Monitoring and Pilot Testing

Water quality and storm drain solids monitoring will take place at Slip 4 and in storm drain locations on site. Pilot testing will occur within a subcatchment of the treatment area. Potential hazards may include fire, heavy equipment, cold stress, heat stress, hand/foot injury, loud noise, slips, trips, falls, portable power/hand tools, stinging insects, thoroughfares, lifting heavy loads, flash floods, eye injury, and boating hazards.

Task 3: Construction Oversight

Construction oversight will take place during the construction of the LTST facility by the environmental consultant. Potential hazards may include fire, heavy equipment, cold stress, heat stress, hand/foot injury, loud noise, slips, trips, falls, stinging insects, thoroughfares, flash floods, truck cranes, utility protection, welding and cutting, portable power/hand tools, excavation/trenching, drilling, lifting heavy loads , and eye injury. It is assumed that the construction contractor will prepare and follow their own HASP.

5. KEY PERSONNEL AND HEALTH AND SAFETY RESPONSIBILITIES

Table 1 lists project personnel and their responsibilities in regard to health and safety concerns on this project.

6. WORKER TRAINING

Project personnel have received a variety of training and medical monitoring in accordance with the company Environmental, Health, and Safety (EH&S) Training Program. Pre-entry briefings and daily tailgate meetings shall also be conducted to facilitate site-specific training.

7. MAPS AND SITE CONTROL

7.1 Routes to Hospital and Urgent Care Facility

A hospital and an urgent care facility near the site have been identified. Figure 1A presents the route to the hospital, for emergency care. Figure 1B presents the route to an urgent care facility, for non-emergency care. Both figures also include the facility name, phone number, and written directions from the site. The figures are included at the front of this HASP.

7.2 Site Map

A site map is presented on Figure 2, located inside the cover of this HASP. The site map is intended to show the location of the work zone(s), to provide on-site orientation, and to delineate evacuation routes. Changes may be made to the site map by the SHSO based on changing site conditions. The site map should be accessible in the work area.

7.3 Buddy System

The buddy system is required for all tasks. The buddy system includes maintaining regular contact with onsite Geosyntec personnel, clients, and/or contractors to periodically check on the condition of site workers. In situations when only one employee is performing field work, on-site personnel must have appropriate communication devices on his/her persons at all times and shall maintain contact with off-site personnel. The field worker, when working alone, must communicate with off-site personnel, at a minimum, of three times daily: (1) upon arriving at the site; (2) midway through the work day; and (3) upon departing from site.

7.4 Controlled Work Zones

APPLIES TO TASK: ☐① ☐② ☐③ ☐④ ☐⑤ ☐⑥ ☐⑦ ☐⑧ ☒ Not Applicable

Three controlled work zones, including an Exclusion Zone, a Contaminant Reduction Zone (CRZ), and a Support Zone, are required for the task(s) indicated above. The Exclusion Zone is defined as the area on site where contamination is suspected and tasks are to be performed. The CRZ is defined as the area where equipment and workers are to be decontaminated as they leave the Exclusion Zone. The Support Zone is defined as the command area and may serve as a staging and storage area for supplies. The location and extent of the work zones may be modified as necessary as site investigation information becomes available. For sites that do not require the three controlled work zones, the area(s) where work is to be performed shall be called the Work Zone.

The boundaries of the Exclusion Zone, CRZ, and Support Zone or the Work Zone shall be marked using the following methods:

- ☐ Warning tape
- ☒ Traffic cones
- ☐ Signs
- ☐ Fence
- ☐ Other: ______________________

7.5 Site Access

Access to the site must be controlled using the following method:

- ☐ Sign in/Sign out log
- ☒ Guard
- ☒ Identification badges
- ☐ Check in with SHSO
- ☒ Other: Boeing sponsor

7.6 Visitors

Visitors to the site may need to be continually escorted for safety purposes. Geosyntec employees must not be allowed into the CRZ or Exclusion Zone or the Work Zone until they have received the proper personal protective equipment (PPE) and they have read, understand, and meet the requirements outlined in this HASP. Other visitors under Geosyntec's direction (subcontractors, etc.) may review this HASP for site familiarity, but they are ultimately responsible for their own health and safety (see disclaimer in Section 1).

7.7 Safe Work Practices

General Safe Work Practices that must be implemented during work activities at this site are listed in Table 2.

7.8 Inspections

For projects with field components lasting longer than one week, the SHSO must conduct periodic health and safety inspections. The inspections must be documented using the Health & Safety Inspection Checklist, presented in Appendix B. The Health & Safety Inspection Checklist records should be kept on file at the project site.

The requirement for periodic inspections is:

- [ ] Not Applicable
- [x] Applicable, and the frequency shall be:
  - [ ] Weekly
  - [ ] Bi-Weekly
  - [x] Monthly or whenever significant changes to site conditions occur.

8. HAZARD ANALYSIS AND MITIGATORS

Site specific hazards have been identified through a hazard analysis. Hazard analysis included a review of chemical, physical, and biological hazards. The analysis also identified health and safety hazard mitigators needed to protect workers, which are presented in Appendix C.

8.1 Chemical Hazards

Potential exposure pathways to chemical health hazard agents include inhalation, dermal exposure, and/or ingestion. To effectively manage risk to exposure, constituents of concern (COCs) have been identified. Potential exposure to these COCs will be mitigated through engineering, administrative, and/or PPE controls. The COCs are documented and/or suspected materials present based on previous operations/activities. The identified COCs for this project are listed in Appendix D with appropriate hazard information, including signs of exposure. Hazard Mitigators, which include control measures and methods to minimize exposure, are presented in Appendix C. Also, airborne levels of COCs may be estimated or measured to evaluate levels of PPE that will be required for individual tasks. The type(s) of air monitoring to be performed are discussed in Section 9.

8.2 Physical Hazards

Physical hazards due to the tasks to be performed (e.g., electrocution due to drilling, etc.) and due to the site setting and condition (e.g., slips, trips, or falls due to rocky terrain, etc.) were analyzed. Hazard mitigators for each physical hazard identified are presented in Appendix C. These hazard mitigators must be implemented for each task in which they are applicable, as summarized in the table in Appendix C.

8.3 Biological Hazards

Biological hazards (e.g., allergic reactions to poisonous plants or insects indigenous to the area, etc.) associated with tasks to be performed were analyzed. Hazard mitigators for each biological hazard identified are presented in Appendix C. These hazard mitigators must be implemented for each task in which they are applicable, as summarized in the table in Appendix C.

9. AIR MONITORING

APPLIES TO TASK: ☐① ☐② ☐③ ☐④ ☐⑤ ☐⑥ ☐⑦ ☐⑧ ☒ Not Applicable

The site does not have any known airborne contaminates that would be at levels of concern within the breathing zone of site workers.

10. PERSONAL PROTECTIVE EQUIPMENT

The levels of PPE required for each task are presented in Appendix F. Required equipment and types of protective clothing materials, as well as an indication of the initial level of protection to be utilized, are listed. The level of protection may be upgraded or downgraded by the SHSO according to mitigation measures required in Appendix C or according to action guidelines provided in Appendix E. The PPE levels that are implemented must be documented in a daily field log.

If respirators are worn, workers must abide by the company's Respiratory Protection Program in accordance with 29 CFR §1910.134. Persons with facial hair that may interfere with the respirator seal may not wear respirators.

11. DECONTAMINATION

The SHSO and Project Manager will determine the type and level of decontamination procedures for both personnel and equipment based on evaluation of specific work activities in the controlled work zones. In an emergency, the primary concern is to prevent the loss of life or serious injury to personnel. Medical treatment will take precedence over decontamination in the event of a life threatening and/or serious injury/illness. Personnel will perform decontamination in designated and identified areas upon leaving "hot zones" where the potential exists for exposure to hazardous chemical, biological, or environmental conditions.

Decontamination of personnel in Level D (modified) will consist of closure and disposal of coveralls, disposable boots, and gloves, (if applicable).

Decontamination of personnel in Level C, if applicable, will consist, at a minimum, of:

- Removal and cleaning/disposal of boot covers, coveralls, and outer gloves;
- Removal, cleaning, and storage of respiratory protection;
- Washing of boots or other non-disposable PPE (e.g., hard hat, safety glasses/goggles, etc.) suspected of being contaminated using a soap solution followed by a water rinse; and
- Removal and disposal of inner gloves.

Wash solutions and PPE may require disposal at a licensed waste facility. Hand tools and sampling equipment shall be decontaminated as needed by washing in decontamination basins with appropriate solutions, or, if possible, by dry decontamination.

12. EMERGENCY PREPAREDNESS AND RESPONSE

A table presenting a list of contacts and telephone numbers for the applicable local off-site emergency responders is provided inside the front cover of this HASP (after figures). If the nature of the site work and COCs requires that off-site responders be notified before work begins on this project, the date that the pre-notification was made is presented in the table.

The following emergency response equipment is required for this project:

- ☒ First Aid Kit
- ☒ Fire Extinguisher (Type ABC)
- ☐ Eyewash bottle
- ☐ Other: ____

In the event of an injury to an employee, the Instructions for Injury Response, located in the front of this HASP, must be implemented immediately. 'Tear-out' forms are located after the Instructions for Injury Response. If professional medical attention is required, these forms must be provided to the medical provider at the time the medical attention is administered. Injury reporting is required per the procedures presented on the Instructions for Incident Reporting, also located in the front of this HASP.

In the event that an emergency develops, the procedures delineated in the Emergency Response Procedures, located in the front of this HASP, are to be followed immediately. (Note that an emergency does not necessarily include an injury.) After the emergency is resolved, post-incident reporting is required per the procedures presented on the Instructions for Incident Reporting, also located in the front of this HASP.

13. CONFINED SPACE ENTRY

☐ APPLICABLE ☒ NOT APPLICABLE

Currently, no tasks are anticipated to require confined space entry. However, if confined space entry is determined to be required at a later date, this HASP will be amended prior to initiating any confined space activities. The HASP amendment will include specific details of the confined space activities, a list of the employee(s) conducting the activities including the appropriate training and PPE necessary to safely conduct the tasks, as well as any other documentation needed to comply with the federal confined space regulations [29 CFR §1910.120(j)].

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Table 1

Key Personnel and Health & Safety Responsibilities

Principal-in-Charge or Associate-in-Charge Eric Strecker	*Project Manager (PM)* Brandon Steets	*Site Health & Safety Officer (SHSO)* Jim Howell	*Project Personnel*	*Environmental, Health & Safety Coordinator (EHSC)* Christy Noble
• Approve this HASP and amendments, if any. • Verify that elements of this HASP are implemented.	• Approve this HASP and amendments, if any. • Monitor the field logbooks for health and safety work practices employed. • Coordinate with SHSO so that emergency response procedures are implemented. • Verify that corrective actions are implemented. • Verify and document that personnel receive this plan and are aware of its provisions and potential hazards associated with site operations, and that they are instructed in safe work practices and familiar with emergency response procedures. • Provide for appropriate monitoring, personal protective equipment, and decontamination materials.	• Prepare and implement project HASP and amendments, if any, and report to the Project Manager for action if any deviations from the anticipated conditions exist and authorize the cessation of work if necessary. • Verify that site personnel meet the training and medical requirements. • Conduct pre-entry briefing and daily tailgate safety meetings. • Verify that all monitoring equipment and personal protective equipment is operating correctly according to manufacturer's instructions and such equipment is utilized by on-site personnel. Calibrate or verify calibration of all monitoring equipment and record results. • Verify that decontamination procedures are being implemented. • Implement site emergency response and follow-up procedures. • Notify the EHSC in the event an emergency occurs. • Perform weekly inspections.	• Provide verification of required health and safety training and medical surveillance prior to arriving at the site. • Notify the SHSO of any special medical conditions (e.g., allergies). • Attend pre-entry briefings and daily tailgate safety meetings. • Immediately report any accidents and/or unsafe conditions to the SHSO. • Be familiar with and abide by the HASP. • Be ultimately responsible for his or her own safety.	• Review and audit HASP and amendments. • Maintain a copy of the cover sheet of each completed HASP. • Notify Director of Environment, Health & Safety in the event an emergency occurs. • Assist with the implementation of the corporate health and safety program. • Consult on health and safety issues.

Table 2

General Safe Work Practices

- Minimize contact with impacted materials. Do not place equipment on the ground. Do not sit or kneel on potentially contaminated surfaces.
- Smoking, eating, or drinking after entering the work zone and before decontamination is not allowed. Employees who are suspected of being under the influence of illegal drugs or alcohol will be removed from the site. Workers taking prescribed medication that may cause drowsiness shall not operate heavy equipment and are prohibited from performing tasks where Level C or B personal protective equipment is required.
- Practice good housekeeping. Keep everything orderly and out of potentially harmful situations.
- Use of contact lenses may not be allowed under certain hazardous working conditions.
- The following conditions must be observed when operating a motor vehicle.
  - Wearing of seat belts is mandatory
  - The use of headlights is mandatory during periods of rain, fog, or other adverse weather conditions
  - A backup warning system or use of vehicle horn is mandatory when the vehicle is engaged in a backward motion
  - All posted traffic signs and directions from flagmen must be observed
  - Equipment and/or samples transported in vehicles must be secured from movement
  - The use of vehicles acquired by Geosyntec by non-Geosyntec personnel is prohibited
- In an unknown situation, always assume the worst reasonable conditions
- Be observant of your immediate surroundings and the surroundings of others. It is a team effort to notice and warn of dangerous situations. Withdrawal from a hazardous situation to reassess procedures is the preferred course of action.
- Conflicting situations may arise concerning safety requirements and working conditions. These must be addressed and resolved rapidly by the SHSO and PM to relieve any motivations or pressures to circumvent established safety policies.
- Unauthorized breaches of specified safety protocol must not be allowed. Workers unwilling or unable to comply with the established procedures must be discharged.

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Appendix A

HASP Amendments

Discuss details of amendments to this HASP here. Include amendment number, date, and details of amendments.

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Appendix B

Health & Safety Inspection Checklist

Project: ____ Date: _______________________

Inspected by: ____

Category	***Observations/Corrective Actions (N/A, if Not Applicable)***
Pre-entry briefing records are current	
Tailgate meeting records are current	
Training/medical surveillance/respiratory protection records are current	
Site map is posted	
Buddy system is implemented	
Work zones are identified	
Site access is controlled	
Visitors are being escorted	
On-site/off-site communications are in working order	
Safe work practices are being implemented	
Any additional hazards incurred?	
Air monitoring equipment is in working condition	
Air monitoring records are being recorded in field logbook	
Air monitoring calibration records are being recorded in field logbook	
PPE storage area is neat and organized	
Standard operating procedures are being implemented	
Housekeeping at decontamination zone is appropriate	
Decontamination procedures are being implemented	
Emergency response equipment is in working condition	
Route to hospital is posted	
Confined space entry program is being implemented	
Spill containment equipment is available	
Chemical inventory is up to date	
Material safety data sheets are available	
Primary and secondary containers are properly labeled	
Housekeeping at the chemical storage area is appropriate	

Appendix C

Hazard Analysis and Hazard Mitigators

TASKS	
① Site Investigation	⑤
② Monitoring and Pilot Testing	⑥
③ Construction Oversight	⑦
④	⑧

TASK #	①	②	③	④	⑤	⑥	⑦	⑧
I. Chemical Hazards								
Fire	x	x	x					
Permanganate Handling								
Reactivity								
Skin absorption		x						
II. Physical Hazards								
Bioaugmentation Culture Handling								
Boating		x						
Chainsaw								
Cold Stress	x	x	x					
Compressed Gas Cylinder								
Downhole Logging								
Drilling (including Indoor)			x					
Drum and Container Handling								
Electrocution								
Excavation/Trenching			x					
Eye Injury		x	x					
Fall Protection	x	x	x					
Flash Flood	x	x	x					
Hand/Foot Injury	x	x	x					
Heat Stress	x	x	x					
Heavy Equipment	x	x	x					
Helicopter								

TASK #	①	②	③	④	⑤	⑥	⑦	⑧
Knives / Blades								
Landfill Gas and Leachate								
Lifting Heavy Loads		x	x					
Lockout/Tagout								
Loud Noise	x	x	x					
Nuclear Gauge Radiation Exposure								
Portable Power/Hand Tool		x	x					
Slips, Trips, and Falls	x	x	x					
Thoroughfares	x	x	x					
Truck Crane			x					
Urban Environments								
Utility Protection			x					
Welding and Cutting			x					
Other:								
III. Biological Hazards								
Allergic Reaction to Poisonous Plants								
Alligators								
Dogs								
Stinging Insects / Vermin / Snakes	x	x	x					
Medical Waste								
Mountain Lions								
Other:								

An X in a box indicates that the listed hazard is applicable to the respective task. The appropriate Hazard Mitigators are presented in this Appendix.

FIRE

- Know fire prevention procedures, fire-fighting techniques and essential precautions to prevent injury.
- Do not stop to get anything out of a building or area if evacuation is required. JUST GET OUT - and assemble in the predetermined evacuation assembly points.
- There are 3 elements to starting a fire: a fuel source, an oxygen source and a point of ignition.
- Know how and when to use different types of fire extinguishers.
- Keep all fire extinguishers in workable condition and accessible at all times. Access to or visibility of extinguishers shall not be obstructed.
- Control static electricity (e.g., ground equipment)
- Remove only the minimum required supply of paints, solvents, or other flammables from storage. At no time shall the quantity removed exceed one day's working supply.
- Do not allow combustible products of rubbish, waste or other residues to accumulate. Oil soaked rags and material subject to spontaneous combustion shall only be stored in non-combustible containers with self-closing lids.
- Do not store gasoline, flammable solvents, and liquids inside a building unless the structure has been approved for flammable storage containers. Only OSHA-approved storage cabinets shall be used for all flammable liquids, paints or solvents.
- Flammable liquids shall be stored in locations that will not interfere with evacuation of the area in case of a fire.
- Do not permit smoking, striking of matches, or other sources of ignition outside of designated "SMOKING" areas.
- Discard cigarette butts, matches or other similar materials in non-combustible containers.

SKIN ABSORPTION

- Be aware of chemicals of concern that can directly injure (corrode, burn, dehydrate) the skin or that can be absorbed into the bloodstream and subsequently transported to other organs from dust, liquid or vapor sources.
- Know that skin absorption is enhanced by abrasions, cuts, heat, and moisture.
- Do not wear contact lenses in contaminated atmospheres (since they may trap chemicals against the eye surface). The eye is particularly vulnerable because airborne chemicals can dissolve in its moist surface and be carried to the rest of the body through the bloodstream (capillaries are very close to the surface of the eye).
- Keep hands away from face.
- Minimize contact with liquid and solid chemicals.
- Wear protective clothing (e.g., suits and gloves) as specified by the Site Specific Health and Safety Plan.

BOATING

- Be aware that personal protective clothing can severely limit swimming ability and affect boat stability.
- If on open water without protection from sunlight, use sun protection. Wear sunglasses to protect your eyes from glare. Attach a neck cord to the sunglasses to prevent loss.
- Carry a waterproof container onboard to hold the following items: sunscreen, insect repellent, sunglasses, emergency contact information, and communication equipment.
- Everyone should carry a personal; waterproof ID that includes emergency contact information.
- Use extra caution in areas where snake or alligators may be present
- Be aware of your surroundings at all times. Stay alert!
- Vessels must be registered as required by applicable state laws to operate a watercraft.
- When conducting electro-fishing activity, the remote circuit interrupter switch must be used.

COLD STRESS

- Work in pairs to keep an eye on each other and watch for signs of cold stress.
- Wear layers of loose fitting clothing, including insulated coveralls, head covering, gloves and boots.
- Minimize wind chill effects by wearing a wind resistant outer shell.
- Minimize lengthy periods of outdoor activity. This may require additional shifts and taking frequent breaks to warm up.
- Provide warm shelter.
- Remain hydrated. There is a tendency not to drink as many fluids when temperature is cold.
- Be aware of the symptoms of cold stress and appropriate first aid measures. Because of the considerable danger to personnel, outdoor work should be suspended if the ambient temperature drops below 0°F or if the wind chill factor drops below -29°F.

Signs and symptoms:

Mild hypothermia

Shivering, lack of coordination, stumbling, fumbling hands, slurred speech, memory loss, pale and cold skin.

Moderate hypothermia

Shivering stops, unable to walk or stand, confused and irrational.

Severe hypothermia

Severe muscle stiffness, very sleepy or unconscious, ice cold skin.

Treatment:

Mild hypothermia

Move to warm area, stay active, remove wet clothes and replace with dry clothes or blankets, cover the head, drink warm (not hot) sugary drink.

Moderate hypothermia

Call for an ambulance, cover all extremities completely, Place very warm objects, such as hot packs or water bottles on the victim's head, neck, chest and groin and follow treatments for mild hypothermia.

Severe hypothermia

Call for an ambulance, treat the victim very gently, cover all extremities completely.

DRILLING (Including Indoor)

- All members of the drilling crews shall be trained in the standard operating safety features and procedures to be utilized during operation, inspection, and maintenance of the equipment.
- Wear hard hats, steel toed boots, hearing protection and safety glasses at all times when performing drilling operations.
- Conduct a survey, prior to bringing drilling equipment to the job site, to identify overhead electrical hazards, potential subsurface hazards, and terrain hazard. Once on site, before drilling equipment is moved, the travel route shall again be visually surveyed for overhead and terrain hazards. Document possible hazards and communicate them to the drilling crew.
- Use only drilling equipment equipped with two easily-accessible emergency shutdown devices, one for the operator and one for the helper. Shutdown devices should be tested at the beginning of each day.
- Do not transport drilling equipment with the mast in the upward position.
- Extend outriggers per the manufacturer's specifications.
- Monitor weather conditions. Operations shall cease during electrical storms or when electrical storms are imminent.
- Wearing of loose clothing (e.g., open shirts, hooded sweatshirts, etc) is not permitted.
- When appropriate use auger guides on hard surfaces.
- Verbally alert employees and visually ensure employees are clear from dangerous parts of equipment prior to starting or engaging equipment.
- Channel the discharge of drilling fluids away from the work area to prevent the ponding of water.
- Use hoists only for their designed intent. Hoists shall not be loaded beyond their rated capacity. Steps shall be taken to prevent two-blocking of hoists (the condition when the lower load block or hook assembly comes in contact with the upper load block, or when the load block comes in contact with the boom tip). Follow the equipment manufacturer's procedures if ropes become caught in, or objects are pulled into a cathead.
- Do not run or rotate drill rods through rod slipping devices. No more than 5 feet of drill rod column shall be hoisted above the top of the drill mast. Drill rod tool joints shall not be made up, tightened, or loosened while the rod column is supported by a rod slipping device.
- Control dust using dust suppression techniques.

- Clean augers, drill casing, or drill rod only when the rotating mechanism is in neutral and the pipe is stationary is stopped.
- Cap and flag open boreholes; open excavations shall be barricaded.
- Keep all hand tools used during drilling operations clean and in good working condition.
- Check fire extinguishers and notify all onsite personnel to their whereabouts.
- Check cables for frays and hydraulic hoses for leaks daily.
- In situations where ambient water level may be above top of well screen, during well construction, ensure that well casing is vented to prevent air pressure build-up in blank casing above screen.

Indoor Drilling

- Conduct a survey, prior to bringing drilling equipment to the job site, to identify ceiling height, overhead hazards, potential subsurface hazards, terrain hazard, and building stability particularly during drilling activities. Identify sources of ventilation (including open doorways for cross ventilation and fans to assist in air flow). Once on site, before drilling equipment is moved, the travel route shall again be visually surveyed for overhead and terrain hazards and avenues of ventilation will be opened or turned on.
- Notify and/or evacuate all building occupants prior to start of drilling activities.
- All drilling rig exhaust will be redirected outdoors by tubing. The perimeter of the outdoor exhaust area shall be roped off a suitable distance to allow proper ventilation of exhaust.
- Monitor ambient oxygen percentage and carbon monoxide concentrations in the work zone, as well as entire indoor area, to prevent low oxygen or high carbon monoxide environments. Operations shall cease and the building will be evacuated if levels become dangerous.

EXCAVATION/TRENCHING

Prior to Excavation

- Confirm that an OSHA competent person is available. An OSHA competent person is someone with enough training to identify soil types and other excavation hazards and authority to take prompt corrective actions.
- Check for the presence of underground and aboveground utilities before conducting any intrusive work. Support, protect or remove utility lines as appropriate.
- Implement the Geosyntec Confined Space Entry Program if employees are to enter excavations or trenches of 4 feet deep or deeper (regardless of width).
- Remove or brace trees, boulders, etc., adjacent to the work area that could fall into the work area before intrusive begins.
- Underpin all nearby existing structures to ensure their stability before excavating below the level of the base of the footing of any foundation or retaining wall.

During Excavation

- Wear hard hats, safety boots and reflective vests.
- Use flagmen or warning devices for all mobile equipment using reverse and forward motion
- Adequately slope or shore all sides of excavations/trenches 5 feet or more in depth (depending on local regulations) before allowing anyone to enter them (see below).
- Store and retain all equipment/material and excavated soil/rock/waste (spoil(s)) at least 2 feet or more from the edge of the excavation/trench.
- Use diversion ditches or dikes to prevent water from entering an excavation, and to provide adequate drainage of the area adjacent to the excavation. Prevent water from accumulating in an excavation.
- Install substantial stop logs or barricades when mobile equipment is used or allowed adjacent to excavations.
- Provide a walkway or bridge with standard guardrails where employees or equipment are required or permitted to cross over excavations.
- Ladders used for ingress/egress should extend a minimum of 3’ above ground surface, be secured, and be located so as to require no more than 25 feet of lateral travel for workers in the trench or excavation.
- Avoid standing on top of trench/excavation while personnel are below, in the trench.

- Examine all excavation work areas and faces for unsafe conditions at least at the beginning of each shift and especially after blasting, a rain, a freeze or a thaw. If unsafe conditions are found, all work in that immediate area shall cease until the necessary
- If it is necessary to place or operate trucks, materials or other heavy objects on a level above and near an excavation, pile, shore, and/or brace sides of excavations to resist the extra pressure due to such superimposed loads.

Shoring an Excavation

- Place cross braces or trench jacks in a true horizontal position, space vertically and secure to prevent sliding, falling or kick-outs.
- Use portable trench boxes or sliding trench shields, if needed, in place of a shoring system or sloping.
- Support systems shall be planned and designed by a qualified professional engineer when the excavation is in excess of 20 feet in depth, adjacent to structures or improvement, or subject to vibration or ground water.
- Removal and backfilling of trench supports must slowly progress together from the bottom of the trench. Jacks or braces shall be released slowly and in unstable soil, ropes shall be used to pull out the jacks or braces from above after employees have cleared the trench.
- Stability of an excavation left open for a long period of time(i.e. more than a few days) should be evaluated by a professional engineer to assess if slopes, bracing measures, etc. need to be modified.
- Start backfilling trench before removing braces in case of Type C soils.
- Put up barricades – flagging tape, fencing to prevent falls into the excavation.
- Cover or secure trench/excavation if left open overnight.

Sloping an excavation

- Excavate to at least the OSHA minimum required angle ratio according to soil classification identified except for areas where solid rock allows for line drilling or pre-splitting.
- Flatten the angle of repose when an excavation has water conditions, silty materials, loose boulders, and areas where erosion, deep frost action and slide planes appear.

Soil Classification	Soil Classification Description	OSHA Minimum Requirements For Side Slopes
Soil Type A	Most stable: clay, silty clay and hardpan (resists penetration)	.75:1 (for one foot vertical rise, the trench wall must be cut back ¾')
Soil Type B	Medium stability: silt, sandy loam, medium clay and unstable dry rock	1:1 (each step has an equal horizontal and vertical rise; only cohesive Type B soils may be benched)
Soil Type C	Least stable: gravel, loamy sand, soft clay, submerged soil or dense, heavy unstable rock	1.5:1 (trench wall must be cut back 1-1/2' for 1' vertical rise; type C soil is not benched)

EYE INJURY

- Wear appropriate eye protection according to the task at hand.

HAZARD	TYPE OF PROTECTION
Impact	Safety glasses with side shield or vented safety goggles
Heat (Sparks)	Vented safety goggles or safety glasses with a face shield
Chemical	Hooded vented safety goggles or full-face respirator (if mild chemicals then safety glasses with side shield is acceptable)
Light Radiation	Tinted/reflective safety glasses or tinted/reflective face shield
Dust	Hooded vented safety goggles

- Apply anti-fog product to lens not previously treated.
- Minimize the amount of vapor or particulate matter generated, if possible.
- Avoid touching the face and eyes.
- Flush eyes with water for at least 15 minutes if chemicals do get into the eyes. If condition persists, seek medical attention.
- If dust or foreign objects are in your eyes, do not rub your eyes.
- If an object becomes embedded in the eye, do not attempt to remove. Lightly bandage your eyes, or both eyes, if possible and immediately seek medical attention.
- Do not wear contact lenses if chemical or dust hazard is present (e.g. decontamination or preservation chemicals used during sampling).
- Provide on-site training to workers before tasks at hand.
- If visitors enter area, stop work until they are properly protected.

FALL PROTECTION

Each worksite and all activities shall be evaluated prior to the start of the job to identify the hazards of falling from any elevation. Site specific fall protection programs shall identify the areas/activities requiring fall protection, the manner in which fall protection will be accomplished, a listing of qualified individuals for fall protection and a roster of personnel authorized to utilize specific fall protection equipment. As part of this evaluation, all applicable requirements of 29 CFR 1926 Subpart M shall be addressed.

- All Geosyntec employees and contracted employees on walking/working surfaces 6 feet or more above the immediate lower level shall be protected from falling by a guardrail system, safety net system, or personal fall-arrest system 100% of the time. This includes working near edges of excavations and trenches and wells and caissons greater than 20” in diameter.

- All elevated work, regardless of the height, shall incorporate job planning to anticipate and mitigate the consequences of a fall. Job planning should include rescue after a fall.

- First consideration shall be given to the elimination of fall hazards. If a fall hazard cannot be practically eliminated, second consideration shall be implementing effective permanent or temporary means of fall prevention.

- Before using any equipment, pipelines, or trusses for elevated work, it must be determined by the project manager if they are suitable for climbing or walking. Not all pipelines, trusses, and hanger systems are designed to support individuals doing elevated work.

- Weather must be a safety consideration whenever outdoor elevated work is to be done. The weather hazard must be addressed prior to and during the work.

- When fall protection is required, a personal fall arrest system must be utilized that complies with 29 CFR 1926.502(d) (full body harness with a fall arrest system)
- Look where you walk to make certain your pathway is clear of hazards.
- Practice safe walking skills.
- Scaffolds/ladders: Both require pre-use inspection for integrity, with particular attention given to scaffold planking (secure and strong), levelness of erection, avoidance of power lines, and bolted pipe connections.

FLASH FLOOD

Before a Flood

- Be familiar of regional or local flash flood history in your work area.
- Be aware if your work area is in a floodplain, and if it is above or below flood stage water level.
- If available, review Flood Insurance Rate Maps (FIRMs).
- Always be aware of the latest weather forecast in your area, especially if your work site is prone to flash flooding.
- In the event of the heavy rain or steady rainfall during work, stop work immediately and head for higher grounds.

Once the Flood Arrives

- Don't drive through a flooded area. If you come upon a flooded road, turn around and go another way. More people drown in their cars than anywhere else.
- If your car stalls, abandon it immediately and climb to higher ground. Many deaths have resulted from attempts to move stalled vehicles.
- Don't walk through flooded areas. As little as six inches of moving water can knock you off your feet.
- Stay away from downed power lines and electrical wires. Electrocution is another major source of deaths in floods. Electric current passes easily through water.
- Look out for animals - especially snakes. Animals lose their homes in floods, too. They may seek shelter in yours.
- If the waters start to rise within your work area before you have evacuated, retreat to high ground such as cars, trucks, and field equipment.
- Take dry clothing, a flashlight and a portable radio with you. Then wait for help.
- Don't try to swim to safety; wait for rescuers to come to you.
- If outdoors, climb to high ground and stay there.

HAND/FOOT INJURY

- Wear protective gloves as required in the Health and Safety Plan. Gloves should be chosen to suit the work being performed (e.g., chemical resistant gloves will be worn when handling chemicals or sampling for suspected chemicals).
- Steel-toed/steel-shanked safety boots must be worn whenever working around heavy objects (or as required by the HASP). Insulated and/or waterproof boots may also be warranted depending on weather conditions. Boots should be inspected periodically for signs of wear (e.g., cracks in rubber or along soles) and replaced as required.
- Durable footwear which provides adequate ankle support should be worn when working in rugged terrain.
- Use proper lifting techniques to avoid dropping heavy loads on hands and feet (refer to lifting heavy loads hazard mitigator)
- Be aware of moving machinery and heavy equipment in the work area and tuck away any loose clothing.

HEAT STRESS

Prevention:

- Drink plenty of hydrating fluids, such as Gatorade® or water. In high heat, a minimum of one gallon per day should be consumed. Fluid should be consumed frequently. Don't wait until thirsty.
- Provide cooling devices, when necessary, to aid natural body heat exchange during prolonged work or severe heat exposure. Devices include field showers, hose-down areas, shade umbrellas/tents, wide-brim hats, and cooling jackets, vests, or suits.
- If amenable to work conditions, wear light-colored, loose fitting, "breathable" clothing.
- Avoid prolonged periods of exposure. Take breaks as necessary. Higher heat exposure requires more frequent breaks.
- Be able to recognize the signs, symptoms and how to treat for heat stress. Signs, symptoms and treatment are listed below.

Signs and Symptoms:

- Mild heat stress - Decreased energy, slight loss of appetite, nausea, lightheadedness.
- Moderate heat stress - heavy sweating, thirst, faintness, headache, confusion.
- Severe heat stress (heat stroke) - Throbbing headache, confusion, irritability, rapid heartbeat, difficulty breathing, dry skin (no sweating), vomiting, diarrhea.

Treatment:

- Mild and Moderate heat stress - Take to cool place, drink cool (not cold) fluids, remove excess clothing, rest.
- Severe heat stress - Call 911 for an ambulance and get to a cool place, remove excess clothing and rest.
- Adjust work and rest schedules as needed. Establish a work regimen that will provide adequate rest periods for cooling down. This may require additional shifts of workers.
- Provide shelter or shaded areas (77ºF is best) to protect personnel during rest periods.
- Maintain worker's body fluids at normal levels to ensure that the cardiovascular system functions adequately. Daily fluid intake must equal the approximate amount of water lost in sweat. Workers are encouraged to drink more than the amount required to satisfy thirst (recommend water and sport drinks, not coffee or soda), because thirst is not an adequate indicator of adequate salt and fluid replacement.
- Remove impermeable protective garments during rest periods.
- Do not assign other tasks to personnel during rest periods.

HEAVY EQUIPMENT

Working around Heavy Equipment

- Yield to heavy equipment.
- Listen for warning signals on heavy equipment.
- Perform a visual inspection and walk around parked heavy equipment before moving to assure that equipment is in good condition and that there are no personnel on the ground that could be injured or objects that could be damaged by vehicle movement.
- Wear hearing protection if required.
- Wear traffic vests for increased visibility.
- Maintain eye contact with the heavy equipment operator when working near equipment.
- Be aware of changes in sound of equipment which may indicate a change in direction.

Heavy Equipment Operators

- Use hand rails and footholds when mounting and dismounting equipment,
- Brakes, steering, clutches and controls shall be tested.
- Pay attention to workers on the ground who may be in the path and provide warning prior to moving the equipment.
- Permit no one to ride on, or in, heavy equipment. This includes any portion of a backhoe, bulldozer, forklift or the back of a pickup truck, except in locations specifically designed for passenger use and approved by the SHSO.
- Keep haulage vehicles under positive control at all times while operating. Vehicles shall be kept in gear when descending grades.
- Do not use heavy equipment on slopes with steepness exceeding 3H:1V unless operations are consistent with manufacturer's recommendations (if the Owner's Manual is not with the equipment or does not specify slope operating procedures, see the SHSO).
- Operate equipment with booms, blades, buckets, beds, etc., lowered or in a stable position while on slopes. Safety cables tethered to appropriate anchors shall be used for equipment working on steep slopes, where appropriate.
- Suspend in slings or support by hoists or jacks heavy equipment in need of repair. The equipment must also be blocked or cribbed before working underneath.
- Shut off motors, do not allow smoking, and use proper dispensing equipment when refueling gasoline-operated equipment to prevent fire hazards.
- Lower hydraulic systems (e.g., blades, etc.) to the ground, set brakes, and shut down equipment if malfunction occurs.
- Use rollover protection and seat belts.

LIFTING HEAVY LOADS

- Proper lifting techniques include:
  - *Feet* - Feet should be parted, with one foot alongside the object being lifted and one behind. Feet should be comfortably spread to give greater stability. The rear foot should be in position for the upward thrust of the lift.
  - *Back* - Use the sit-down position and keep the back straight, but remember that "straight" does not mean "vertical". A straight back keeps the spine, back muscles, and organs of the body in correct alignment. It minimizes the compression of the abdomen that can cause a hernia.
  - *Arms and Elbows* - The load should be drawn close to the body, and the arms and elbows should be tucked in. When the arms are held away from the body, they lose much of their strength and power. Keeping the arms tucked in also helps keep body weight centered.
  - *Palm* - The palm grip is one of the most important elements of lifting. The fingers and the hand are extended around the object to be lifted. Use the full palm; fingers alone have very little power.
  - *Chin* - Tuck in the chin so the neck and head continue the straight back line. Keep the spine straight and firm.
  - *Body Weight* - Position the body so its weight is centered over the feet. This provides a more powerful line of thrust and assures better balance. Start the lift with a thrust of the rear foot. Shift hand positions so the object can be boosted after knees are bent. Straighten knees as object is lifted or shifted to the shoulders. To change direction, lift the object to a carrying position, and turn the entire body, including the feet. Do not twist your body. In repetitive work, both the person and the material should be positioned so that the worker will not have to twist his body when moving the material. If the object is too heavy to be handled by one person, get help.

- Limit continuous lifting of weights to 50 pounds or the maximum allowed by the client whichever is less. Lifts of heavier weights are permitted on an interim basis. Help shall be obtained for lifting of loads greater than 50 pounds or the maximum allowed by the client whichever is less. Mechanical equipment should be used on heavy materials when possible. If mechanical assistance is not available, adequate manpower to maintain the 50-pound limit per employee will be required.
- Do not lift more weight than can be handled comfortably, regardless of load weight. If necessary, help should be requested to lift a load so that the lifting is comfortable.
- Use drum dollies when moving drums or barrels.

- Inspect objects for grease or slippery substances before they are lifted to ensure that the object will not slip.
- Do not carry long, bulky or heavy objects without first verifying that the way is clear and that vision is unobstructed. This ensures that other persons or objects will not be struck by the load.
- Do not carry loads that cannot be seen over or around.
- Exercise caution when lifting above the chest level.
- Make sure workers are physically suited for the job before assigning jobs requiring heavy and/or frequent lifting. A person's lifting ability is not necessarily indicated by his height or weight.
- Before lifting an object, consideration should be given to how the object will be set down without pinching or crushing hands or fingers. For example, to place an object on a bench or table, the object should be set on the edge and pushed far enough onto the support so it will not fall. The object can then be released gradually as it is set down, and pushed in place with the hands and body from in front of the object.
- When two or more people are handling the same object, one should "call the signals". All the persons on the lift should know who this person is and should warn him if anyone in the crew is about to relax his grip.

LOUD NOISE

- Wear hearing protection in areas with constant or loud noise.
- Know the effects of noise, including:
  - Workers being startled, annoyed, or distracted.
  - Physical damage to the ear, pain, and temporary and/or permanent hearing loss.
  - Communication interference that may increase potential hazards due to the inability to warn of danger and proper safety precautions to be taken.
- Implement the company Hearing Conservation Program when noise exposures equal or exceed an 8-hour, time-weighted average (TWA) sound level of 85 decibels on the A-weighed scale (dB).
- Utilize feasible administrative or engineering controls if workers are subjected to noise exceeding an 8-hour TWA sound level of 90 dB.

PORTABLE POWER/HAND TOOL

- Read instruction manual for the safe operation of any portable power tool.
- Route cords, hoses, and cables to prevent tripping hazards or contact with equipment.
- Avoid abusing the power supply lines of portable equipment. Excessive scraping, kicking, stretching, and exposure to grease and oils will damage lines or cause them to fail prematurely, and possibly injure the operator or fellow workers.
- Inspect cords, hoses, and cables for wear or deterioration.
- Do not use electrically powered tools near flammable materials or explosive atmosphere, unless they are of the explosion-proof type meeting the National Electrical Code for potentially explosive work areas. Employees operating the equipment should be aware of sparks and or metal fragments when using this equipment.
- Ground-check portable electric power tools with metal cases initially and quarterly. At no time will electrical power equipment be operated without proper grounding. All electrical cords and cables, including extension cords, shall include a third wire ground.
- Prohibit operations of electric tools in wet or damp areas.
- Size cords adequately for length and the electrical demand of the tool. Otherwise, they may cause a fire hazard.
- Limit use of tools to the purpose for which the tool is intended (e.g., wrenches will not be used as hammers). Defective tools (e.g., with mushroomed heads or split or defective handles) shall not be used.
- Keep tools free of accumulated dirt and unnecessary oil or grease. Moving and adjustable parts shall be lubricated frequently to prevent wear and misalignment.
- Replace or repair damaged or worn tools promptly. Temporary or makeshift repairs are prohibited. At the discretion of the supervisor, discard all tools that cannot be repaired safely. Supervisors shall decide when to discard a tool.
- Store tools in suitable boxes or containers. Loose tools shall not be stored on ledges or where they might fall. Tools shall be picked up when a job is completed and not be allowed to accumulate in the work area. Store all tools in a safe place.
- Do not use conducting (i.e., metal) tools around electrical facilities. Insulated tools, approved for electrical work, shall be tested frequently for proper insulation.
- Select the correct size and type of wrench for each job. Wrench handles shall not be extended with a pipe or cheater because the jaws will spread.
- Repair mushroomed punch, drift and chisel heads. Mushroomed heads represent crystallized metal that will break and fly off when struck.
- Wear eye protection at all times.

SLIPS, TRIPS, AND FALLS

- Wear the proper foot wear and clothing for the task at hand.
- Pay attention to the work environment and become aware of all equipment and vehicles active onsite and use caution when moving about.
- Use caution when walking on sloped areas (especially geosynthetics), particularly when moisture is present. Use caution when walking on soft or uneven surfaces; e.g., marsh areas. Watch for icy conditions in cold weather.
- Follow the established designated safe paths for travel and keep these areas free from debris. Avoid steep or slippery slopes and paths near operation vehicles and equipment.
- Follow good housekeeping procedures. Never assume that someone else will clean up a spill or put away an object.
- Remove or clearly mark objects that pose tripping hazards.
- Prevent water accumulation where practicable.
- Cables and/or wiring should be taped down, when possible. Locate cables and/or wiring out of the commonly used areas.
- Mark or repair any opening or hole in the floor.
- Carry objects in a manner that allows you to see in the area you are moving in. Do not carry objects that are too large or bulky. Do not carry more weight than you can balance and keep stable. Understand that PPE can reduce or limit your field of vision and mobility.
- Use the proper ladder for the task at hand and do not exceed the recommended height. Do not use the top two rungs of a ladder. Ensure a flat and stable footing for the placement of a ladder. Utilize the buddy system to help secure the ladder. When working over 6 ft., utilize fall prevention measures. Obey height and weight guidelines and/or rules.
- Use the handrail when using stairs. Be aware of stairway blockages.
- If conditions even slightly resemble an unsafe environment, do not make any assumptions that the integrity of a workplace is intact.
- Never jump over or into a trench or excavation.
- Walk, do not run.
- Maintain proper lighting so obstacles are clearly visible

THOROUGHFARES

- Obtain necessary permits to use/block public thoroughfares.
- All care should be taken to ensure the integrity of walking and working surfaces, including the use of barriers, toe-kicks, etc. to warn personnel and the public of the potential fall and tripping hazards. Guardrails or barrier walls should be constructed surrounding open pits and trenches as appropriate.
- Traffic control plans will be produced and followed when required by the permitting agency or when working on or adjacent to a highway or a busy street. The traffic control plan shall be brought to the site and shall delineate the locations of applicable signs, signals and barricades; describe the necessity for flaggers; and provide other traffic control information..
- Signaling equipment and directions by flaggers shall conform to the latest edition of the U.S. Department of Transportation – Federal Highway Administration, Manual on Uniform Traffic Control Devices for Streets and Highways (http://mutcd.fhwa.dot.gov).
- Flaggers shall be provided with and shall wear fluorescent orange-red or fluorescent yellow-green garments while flagging. Warning garments worn at night shall be made of reflective material. The garments should meet the requirements of ISEA, American National Standard for High-Visibility Apparel.
- Barricades for protection of employees shall conform to the portions of the latest edition of the U.S. Department of Transportation – Federal Highway Administration, Manual on Uniform Traffic Control Devices for Street and Highways (http://mutcd.fhwa.dot.gov), relating to barricades.

TRUCK CRANES

Working with Cargo Bed Mounted Truck Crane

- Make sure vehicle is in park with the parking brake on.
- Truck should be parked on as level of a surface as possible.
- Make sure the control unit connectors are plugged into their proper plug locations.
- Check the crane for proper support pin placements and that the crane unit is secured properly.
- When lowering or raising the cable, make sure hands and clothing are away from the pulleys and winch mechanism.
- Maintain eye contact with the crane operator when working near equipment.
- Be aware of changes in sound of equipment which may indicate a change in direction or fatigue with equipment.
- Hand signals may be needed to communicate with crane operator in areas with loud noise.

Lifting Loads with Cargo Bed Mounted Truck Crane

- Respect the load capabilities of the unit at all times. Capacity is 500 Lbs for trucks with GVWR of 8800 pounds or less and 750 Lbs for trucks with GVWR of 8800 pounds or greater. (GVWR specifications of trucks can be found on sticker located on the driver side door jam).
- Make sure the load is secured correctly to the crane cable.
- Make sure the load that will be lifted in not secured, bolted down, or attached in anyway before lifting.
- Equipment used to secure load to the truck crane should be properly rated for the load being lifted.
- Know the weight of the load being lifted, and make sure it falls under the maximum lift load of the crane.
- Do not put any part of body under the crane boom or lifted loads at any time.
- Load lifting should be as close to vertical (plumb) as possible. Be aware of swinging loads once lifted.
- Lift and drop load at a safe rate of speed.
- When rotating the load, make sure that the pathway way is clear of equipment and personnel.
- Do not stand between crane cable and truck at any time.

UTILITY PROTECTION

The occurrence of above and below-ground utilities should be anticipated at every site. The traditional method of using existing "as built" plans and maps (if available) and probing in the field (i.e., "hunt and hope") is not sufficient to provide adequate assurance that utilities are not impacted during site activities. Geosyntec developed this Utility Protection Hazard Mitigator to implement prior to conducting intrusive site activities (i.e., drilling, well installation, trenching, excavation, hand auguring, etc.). The objective of the Utility Protection Hazard Mitigator is to describe the process necessary to investigate, and to the extent practical, identify utilities in work areas for the purpose of avoiding the utilities, protecting utilities and site personnel, and mitigating impacts to site operations.

Approximate location of subsurface installation means a strip of land not more than 24-inches on either side of the exterior surface of the subsurface installation.

Excavation means any operation in which earth, rock, or other material in the ground is moved, removed, or otherwise displaced by means of tools, equipment, or explosives in any of the following ways: grading, trenching, digging, ditching, drilling, auguring, tunneling, scraping, cable or pipe plowing and driving, or any other way.

High priority subsurface installation means high-pressure natural gas pipelines with normal operating pressures greater than 415 kPa gauge (60 psig) or greater than six inches nominal pipe diameter, petroleum pipelines, pressurized sewage pipelines, high-voltage electric supply lines, conductors, or cables that have a potential to ground of greater than or equal to 60 kilovolt (kV), or hazardous materials pipelines that are potentially hazardous to workers or the public if damaged.

The Mitigator process is summarized below:

- Identify the location of the planned intrusive activities.
- Mark the planned work area with white water based marking paint. If work area is not visible from the street either because of obstruction or distance, provide distance from street to work area (i.e., 150 feet north).
- Contact DigAlert or dial 811 (nationwide) to identify utilities in your work area. http://www.digalert.org/ (811) provides a link to the local state operated "Call-Before-You-Dig" service.
- Review existing utility maps with facility personnel and determine the approximate numbers and types of utilities within the project area. This is inclusive of below-ground utilities that may be encountered during intrusive operations as well as overhead utilities that may be encountered during operations (i.e., drilling mast and overhead power lines).
- Most "Call-Before-You-Dig" services will only mark below-ground utilities leading to the site utility meter. With the exception of high priority utilities (as defined above), utilities present after passing through the site meter may be left without adequate inspection. In such cases, the use of a private utility location firm may be prudent to ensure thorough identification of utilities.
- Retain the services of a private utility locating company that can identify metallic utilities and anomalies in the vicinity of the work area. Private utility location firms use a variety of location techniques. The suspected types of utilities should be discussed

with the private utility location firm to ensure that proper techniques are used. Improper techniques may result in missed or improperly identified utilities.

- DigAlert must be called at least 48 hours prior to the start of work to complete a utility inspection. (For example, if you notify DigAlert on Tuesday at 9:43 a.m. no work can begin until Thursday at 9:43 a.m.)
- Record the inspection confirmation number. Confirm that the inspection was conducted prior to the start of work. The inspection confirmation number is critical in the event that an unmarked utility is encountered, or if a utility identified during the inspection request did not mark the site for the presence or absence of the utility (no-show). If a no-show occurs with it may be possible that the utility operator sent a facsimile care of the project manager (identified during utility inspection request) indicating that there are no conflicts in the planned work area. However, if there is any question, contact DigAlert immediately and request that the missing utility please call to confirm presence or absence of utility in work area or schedule a meeting time at the site.
- After below-ground utilities are identified, the utilities should be marked. The most common marking method is paint or pin flags. The following marking colors are generally widely accepted to demarcate specific types of utilities, but should be confirmed.

RED	ELECTRIC
YELLOW	GAS, OIL, STEAM
ORANGE	COMMUNICATIONS
BLUE	POTABLE WATER
PURPLE	RECLAIMED WATER
GREEN	SEWER / DRAINAGE
PINK	SURVEY MARKS
WHITE	PROPOSED EXCAVATION

- Above-ground utilities should be visually identified. Warning signs may be placed in work areas to remind workers of the above-ground utilities. Other techniques such as shielding or utility relocation may be necessary to make the work safe. Proper set back and approach distances must be maintained at all times.
- Be observant of above-ground features at a site that may be indicative of an underground utility line. An example of this would be noticing two fire hydrants and noting that there is likely a buried water line between them, sings of trenching activities, asphalt or concrete patches, or linear depressions in the ground surface.
- Following the completion of the utility marking, the work area should be inspected by all members of the project team (client, engineer, and contractor) to inspect and discuss the finding. Adjustments to site operations, if necessary, should be discussed and agreed

upon by the project team prior to initiation of site work. If possible, work areas should be re-located away from utilities.

- If conditions allow, consider using vacuum excavation.
- Depending on the proximity of utilities to the work area, low impact soil removal techniques (potholing) may be necessary to either confirm the presence of utilities or to provide protection of utilities before invasive activities. In such cases, hand excavation, hand auguring, vacuum excavation, water jet removal, or other low impact removal techniques may be necessary to a depth of 3 to 5 feet (or other depth as determined by project-specific conditions). In cases where a high priority utility is located within 10 feet of the work area, documentation from the utility owner must be obtained allowing potholing before any work can be conducted. If the utility is not found after potholing is conducted, contact DigAlert and the utility owner immediately to request additional information as to the location of the utility. It is necessary to conduct potholing activities before any work can be conducted in the vicinity (within 10 feet) of the high priority utility.
- If utility location markings are lost, damaged, or faded, a new utility location survey should be conducted to replace the missing or damaged markings. Please note that some municipalities require that all utility markings be removed after work is completed. Black spray paint may be used to cover up utility markings in the street but must be removed from sidewalks.
- In all cases, State, local, utility-specific requirements, facility-specific controls, permits, and operations should be considered and incorporated into the Utility Protection Hazard Mitigator.
- Utility protection should be addressed during each tailgate or job briefing in order to reinforce below-ground utility location and the avoidance of above-ground utilities.

WELDING AND CUTTING

- Reduce exposure to all welding emissions using engineering controls (ventilation) and safe work practices.
- All persons who weld or cut must be properly trained. Associated hazards include:
  - Thermal
  - Chemical fumes
  - Physical injury
  - Volatile combination of heat and gas
  - Radiation from unfiltered ultraviolet light
  - Electrical circuit
  - Gas leakage
  - Excessive noise
  - Poisoning
- Preventative fire measures include use of a welding blanket, removal or covering of flammable materials, and working a safe distance from flammable materials.
- Wear hearing protection, as required.
- Ensure that there is adequate lighting in the work area.
- Utilize the proper protective clothing and equipment (PPE), including:
  - Shield or helmet with filtered lens
  - Fire-resistant gloves
  - Leather apron
  - Overalls
  - Boots
  - Leather spats
  - Felt skullcap or beret
  - Hand shields
- Read the MSDS sheets for all hazardous substances with which you may come into contact prior to starting work.
- Never cut off the tops of drums that have contained flammable liquids or gases. Vapors left inside the drum may explode! If a drum that has held toxic or flammable substances must be cut, it should be filled with water, or thoroughly cleaned of such substances by a specialist cleaning company, then ventilated and tested.
- Do not apply heat to drums that have held chemicals because it may cause them to produce poisonous gas.
- Never weld or grind near an empty drum. A single spark inside an empty drum can trigger an explosion. Keep torches, flames and sparks away from grinding and welding equipment.
- Under no circumstances should fittings of oxyacetylene equipment be allowed to become contaminated with grease or oil, which can ignite in the presence of pure oxygen.
- Have flashback arrestors fitted to all oxyacetylene equipment to overcome the danger of flashback.
- Store oxygen and gas separately. Store acetylene cylinders upright to prevent explosion. Always chain stored cylinders.

STINGING INSECTS / VERMIN / SNAKES

- Be able to recognize stinging insects/vermin/snakes indigenous to the site location and habitats. Learn the indigenous dangerous species (e.g., spiders, snakes, ticks) prior to entering the field and know the first aid treatments.
- Venomous snakes swim on top of the water, non-venomous snakes swim with only their heads above water.
- Advise the SHSO if you have allergies to any insects prior to engaging in any field activities.
- Include the following preventative measures as necessary: wear light-colored clothing, keep clothing buttoned, tuck pant legs into socks, keep shirt tails tucked in, boots, hoods, netting, gloves, masks, insect repellants or other personal protection.
- Snake bite kits are commercially available and should be carried by field personnel when working where venomous snakes exist. In the case of a snake bite, keep the patient calm, restrict activity and immobilize the bite area (do not elevate), and immediately obtain medical attention.
- Report any bites or stings to the SHSO and seek medical attention immediately.
- Be aware of potential hive/nest locations, which may include culverts, drainage pipes, junk piles, or dense shrubbery.
- Advise the SHSO if you are allergic to stinging insects prior to engaging in any field activities.
- Include the following controls:
  - Do not agitate stinging insects or disrupt their hive/nest.
  - Wear light-colored clothes.
  - Avoid wearing perfumes, hair spray, or scented lotions in the wilderness.
- If attacked:
  - <u>Do not</u> scream or wave arms.
  - Cover your face with your hands.
  - Run for shelter in a building or vehicle. Do not seek shelter in water.
  - Remove stingers as quickly as possible to lessen the amount of venom entering the body. Remove the stinger by raking your fingernail across it. Don’t pinch or pull the stinger out. Put ice on the sting to reduce the swelling.

Report any stings to the SHSO and seek first aid or emergency medical care immediately if stung several times.

Appendix D

Constituents of Concern (COCs)

Constituent[1]	***Medium***[2]	***Maximum Concentration***[3]
PCBs	Water	0.27 ug/L
PCBs	Solids	25 mg/kg

Footnotes:

1 Constituents that are included on this list have either been detected at the site at concentrations that may cause potential dermal, ingestion, or inhalation hazards, or the constituent is suspected to potentially be present at elevated concentrations but no analytical data are available.

2 Type of medium (i.e. soil, water, sludge, etc.).

3 Maximum concentration previously detected for the constituent based on historic data (if available). Liquid concentrations are presented in micrograms of constituent per liter of solution (ug/L). Solids concentrations are presented in milligrams of constituent per kilogram of soil (mg/kg). Soil gas and/or vapor concentrations are reported in milligrams of constituent per cubic meter of gas/vapor (mg/m^3).

COC FACT SHEET - POLYCHLORINATED BIPHENYLS (54%)

CAS Number:11097-69-1	**Molecular Weight: 326.0**	**Color: Colorless to Pale Yellow**	**Ionization Potential (eV): NA**	**Vapor Density (Air=1):NA**
Synonyms: Chlorodiphenyl (54%); PCB	**Physical State: Liquid or Solid**	**Odor: Mild hydrocarbon**	**Henry's Constant: NA**	**Vapor Pressure: 0.00006 (mmHg@20C)**

Fire Hazard **NFPA rating: 1** **HMIS rating: 1**

Flash Point(°F): NA
LEL(%): NA UEL(%): NA

Fire Extinguishing Media:
☒ Dry Chemical
☐ Water Spray ☒ CO_2

Fire Extinguisher:
☐ Class A
☐ Class C
☒ Class A/B/C

DOT: ☐Flammable Liquid ☐Combustible Liquid

Reactivity Hazard **NFPA rating: 0** **HMIS rating: 0**

Incompatibilities: Strong oxidizers

DOT: ☐ Oxidizer ☐ Water Reactive

Health Hazard **NFPA rating: 2** **HMIS rating: 2**

Odor Threshold (ppm): NA

IDLH (mg/m^3): 5

	TWA	STEL	C
Source	(mg/m^3)	(mg/m^3)	(mg/m^3)
OSHA PELs	0.5	NA	NA
ACGIH TLVs	0.5	NA	NA

Signs/Symptoms of Acute Exposure: Irritation of eyes; chloracne

DOT: ☐Poison

Carcinogenic:
OSHA: ☐Yes ☒ Not listed

IARC: ☐ Group 1 ☒ Group 2A ☐ Group 2B ☐ Group 3 ☐ Group 4 ☐Not listed

NTP: ☐ Known ☒Anticipated ☐Process ☐ Not listed

ACGIH: ☐ A1 ☐A2 ☒A3 ☐A4 ☐A5 ☐ Not listed

Skin Absorbable: ☒Yes ☐ No
Skin Corrosive: ☐Yes ☒No

DOT: ☐ Corrosive

Air Monitoring

Type	Brand/Model No.	Calibration Method/Media
☐ Explosimeter		
☐ PID		
☐ FID		
☐ Colorometric Tubes		
☐ Chemical Monitor ☐ Dust Monitor	MIE MiniRam	Factory calibrated
☐ Collection Medium/Sampling Pump	Gilian Pump/NIOSH#5503	Calibrate pump w/ media

Protective Clothing

Glove Type/Brand (Breakthrough >2 hrs unless noted):

☐Viton/North	☐Viton/Best	☐Silvershield/North	☐4H/Safety
☒Neoprene/Mapa	☐Neoprene/Ans.Ed.	☐Neoprene/BestUltraflex	☐ Neoprene/BestNeo.(30min)
☐PVC/Ans.Ed.	☐PVC/BestHustler	☐Nitrile/LabSafe.	☐Nitrile/Ans.Ed.
☐Butyl/North	☐PVA/Ans.Ed. #####	☐Other	

Suit Type (Breakthrough >1hr unless noted): ☐Tyvek##### ☐ Tyvek QC(20min) ☐Tyvek/Saranex##### ☐Tychem7500 ##### ☐Tychem 9400##### ☐Tychem 10,000#####☐Other

Respiratory Protection

☐Air Purifying ☐Air Supplied Only

Maximum Use Concentration (ppm): Half mask: Full face:

Notes:
Prepared by: Avianne Louie-Smith, Sherry Hall

Date: 18 October 2010, 16 January 1997, Rev. 31 January 2002

Geosyntec consultants

Appendix E

Air Monitoring Equipment, Frequency of Readings, and Action Guidelines per Task

Applies to Task: ☐ ① ☐ ② ☐ ③ ☐ ④ ☐ ⑤ ☐ ⑥ ☐ ⑦ ☐ ⑧

☐ ***Explosimeter***	☐ ***Oxygen Meter***	☐ ***Photoionization Detector***
Brand/Model No.: _______ ___________ **Monitoring Frequency:**____ ___________	**Brand/Model No.:** _______ ___________ **Monitoring Frequency:**____ ___________	**Brand/Model No.:**________ ___________ **Monitoring Frequency:**____ ___________
Source Reading (% LEL) / **Action** 1 to 10 — Continue with caution. Greater than 10 — Stop work. Evacuate the area. If upon return, if concentration still exceeds 10% LEL, ventilate until concentration is back to <10% LEL. **Note:** _______	**Reading (%)** / **Action** Less than 19.5 — Stop work. Evacuate the area. 19.5 to 23.5 — Continue to work with caution. Greater than 23.5 — Stop work. Evacuate the area. **Note:** _______	**Breathing Zone Reading (ppm)** / **Action** _____ to _____ — Level D PPE _____ to _____ — Level C PPE Greater than ________ — Stop work. Evacuate the area. If upon return, levels still exceed ____, stop work and implement engineering controls. **Note:**_______
☐ ***Flame Ionization Detector***	☐ ***Chemical Detector Tube***	☐ ***Other***
Brand/Model No.: _______ ___________ **Monitoring Frequency:** ___ ___________	**Brand/Model No.:** _______ ___________ **Monitoring Frequency:** ___ ___________	**Brand/Model No.:**________ ___________ **Monitoring Frequency:** ___ ___________
Breathing Zone Reading (ppm) / **Action** _____ to _____ — Level D PPE _____ to _____ — Level C PPE Greater than _______ — Stop work. Evacuate the area. If upon return, levels still exceed ____, stop work and implement engineering controls. **Note:** _______	**Breathing Zone Reading (ppm)** / **Action** _____ to _____ — Level D PPE _____ to _____ — Level C PPE Greater than ________ — Stop work. Evacuate the area. If upon return, levels still exceed ____, stop work and implement engineering controls. **Note:** _______	**Breathing Zone Reading** / **Action** _____ to _____ — Level D PPE _____ to _____ — Level C PPE Greater than ________ — Stop work. Evacuate the area. If upon return, levels still exceed ____, stop work and implement engineering controls. **Note:** _________________

Appendix F
Personal Protective Equipment per Task

	Task ①	Task ②	Task ③	Task ④	Task ⑤	Task ⑥	Task ⑦	Task ⑧
Potential PPE Level per Task:	☒ D ☐ C	☒ D ☐ C	☒ D ☐ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C

Modified Level D*		***Level C****	
Equipment	***Material/Type***	***Equipment***	***Material/Type***
☒ Protective clothing	Long pants/Long sleeves	☐ Full-face air-purifying respirator	Cartridge Type:
☒ Outer gloves	Neoprene	☐ Half-mask air-purifying respirator	Cartridge Type:
☐ Outer boots		☐ Protective clothing	
☒ Hard hat** (for active construction areas only)		☐ Outer gloves	
☒ Safety glasses**		☐ Inner gloves	
☒ Hard-toed boots**		☐ Outer boots	
☒ Hearing protection**		☐ Hard hat**(for active construction areas only)	
☒ Other: Orange vest		☐ Safety glasses**	
		☐ Hard-toed boots**	
		☐ Hearing protection**	
		☐ Other:	

*	If checked, indicates initial level of PPE. Other completed columns indicate information to upgrade/downgrade.

**	Optional as applicable